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University vs. Industry

WHAT is the university's position in our advancing technology and our changing educational economy? We suspect it is not a very comfortable one. Trouble seems to be developing from many directions. Much of it has to do with the university's relations with research—governmental and industrial. Much of it has to do with the disposition and utilization of the inevitable results of that research—patents.

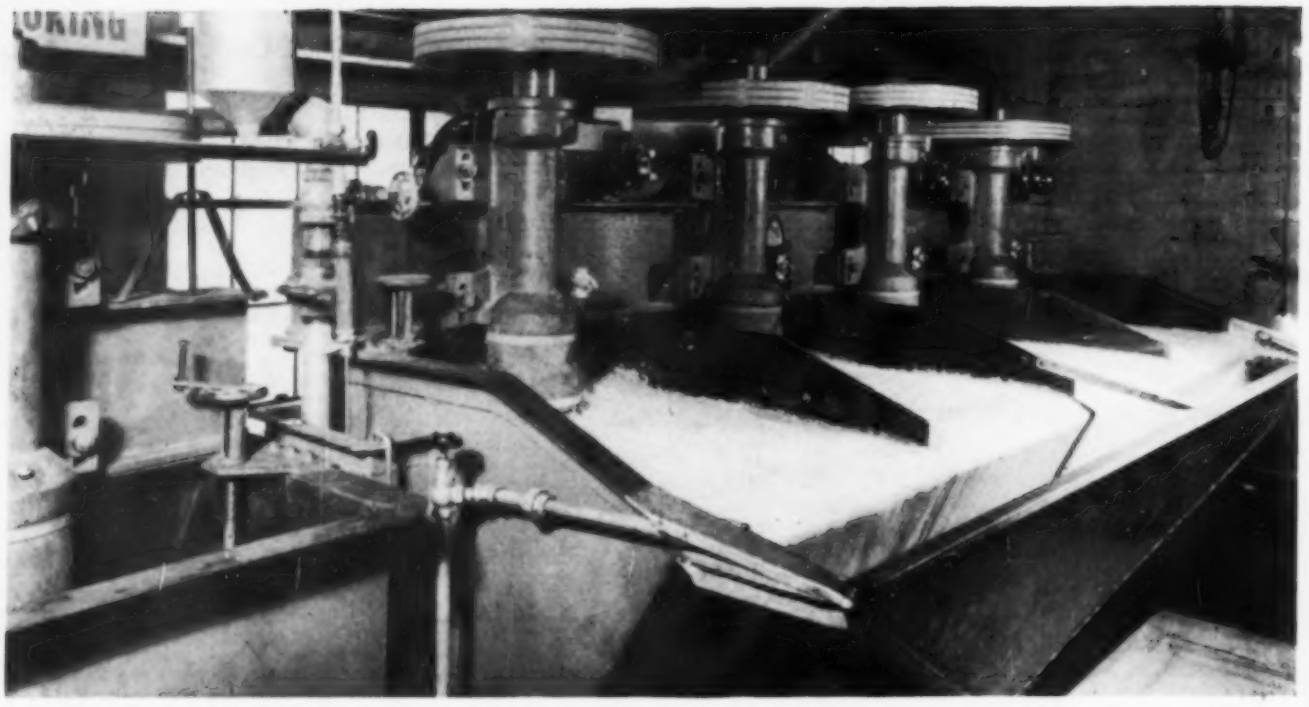
Some of these patents have proved so profitable in recent years that many money-starved institutions have gone into the research business in a big way. Many so-called foundations have been established for no other purpose than to bolster the finances of schools that can no longer live within the waning returns from tuition and endowments. And there is a mounting rumble of complaint about the growing competition between tax-free institutions of learning and tax-paying consultants and research corporations.

It would be presumptuous on our part to pass judgment or enter into any detailed discussion of the tax aspects or of university patent policies. But there are some excellent and authoritative sources of information available for those who would further pursue these problems. Dr. Robert R. Williams, director of grants for the Research Corporation, recently told the annual meeting of the Association of Consulting Chemists and Chemical Engineers that the use of university facilities for consulting work and industrial research represents a diversion from the fundamental purposes of an educational institution. "If I were a university administrator," he said, "I should examine this aspect with greatest care, for nothing can be more stultifying than to try to serve two masters whose interests are in conflict."

Dr. Williams also had clear-cut comments on the management of inventions, holding that patents must never become a prime objective of university research. "To assign the inventions to him (a commercial sponsor) is to confess that the university contributed nothing to the venture that was not paid for by the sponsor's fee. This in turn means that the research was not in the public interest, and therefore inappropriate for the university to undertake at all." Theoretically, the academic laboratory should concentrate on basic scientific research and leave to industry the engineering applications of the fundamental results. But this is not always possible or desirable. Industrial contacts usually broaden the perspective of the teacher, lend an atmosphere of reality to his training program. So the answer, it seems, must be one of restraint and balance—keeping in mind that consulting work must never interfere with the major responsibilities for education and fundamental research.

Dr. Archie M. Palmer, of the National Research Council, has just completed a survey of university patent policies that will warrant careful study by all concerned. With remarkable thoroughness and objectivity, he has analyzed the prevailing practices of our principal universities. Verbatim statements of formalized policies are cited for almost forty institutions. And through the entire volume runs the threat of mounting trouble if basic research is to suffer because of the great tide of developmental projects now being sponsored by government and industry.

The views we have quoted here would seem to indicate that a serious breach has been developing between some of our educational institutions and the industries that are in effect the customers for their principal product. This is most unfortunate, especially at a time when a current shortage of trained scientific personnel in industry is coupled with a critical need for more basic research from the universities. Recognizing each other's problems and logical spheres of activity is the first step toward eliminating what most impartial observers feel is unfair, if not unethical, competition.



Cells like these will be more common as the chemical industry uses more . . .

Froth Flotation

L. A. Roe
Jones & Laughlin Steel Corp.
Negaunee, Mich.

TODAY, more than ever before, one may read and hear a great deal about our vanishing natural resources. It is well realized by most mineral and chemical engineers that mineral supplies and other chemical raw materials are not inexhaustible. Tomorrow's technology will make today's worthless mineral deposits and industrial wastes valuable sources of metals and other chemical raw materials. The chemical industry is interested in the future supply of chemical raw materials, the separation processes which will be used to recover them, and applications of these processes to existing problems in the chemical, food, and process industries.

Mineral separation processes all utilize differences in the physical and electrical properties of the valuable mineral and the gangue or waste rock. Froth flotation, a concentration method dependent upon differences in the surface energy of particles, has in the past been somewhat neglected by the chemical engineer in his search for separation processes. From the standpoint of tonnage of ore treated, the flotation process is by far the most important separation process used in the mineral separations industry. Many mechanical concentration methods which utilize differences in specific gravity, permeability, or electrical conductivity have found ready acceptance in the field of chemical engineering. It is interesting to note that much of the machinery used for two important operations of the chemical industry, thickening and filtering, was invented for use in mineral beneficiation processes. The Dorr thickener, the Oliver, Kelly and Sweetland filters, and the plate-and-frame filter press are among the various machines invented for use in the mineral industry and which were accepted by the chemical industry soon after their inception. Even though the invention of the froth flotation process initiated revolutionary changes in the mineral separations industry, little attention has been given this new separation process by the chemical industry.

Flotation, as a large scale concentration process, is now about forty years old, and has passed through several distinct stages of development which may be divided as follows: (1) flotation of metallic ores, (2) flotation of non-metallic ores, and (3) flotation of water-soluble ores.

An outstanding example of the application of flotation to metallic ores is the flotation of copper bearing minerals. The chief sources of copper are the low grade porphyry copper deposits such as those at Bingham Canyon, Utah; Morenci, Ariz.; and the Chino Mine at Santa Rita, N. M. Most of these ores contain less than eighteen pounds of copper per ton of ore, yet the flotation process effectively removes most of this small amount of metal.

Process Advancement

The advancement of the flotation process to the recovery of large tonnages of non-metallic ores was first practiced in the phosphate fields of Florida. In this process, phosphate minerals are separated from siliceous minerals by flotation. Later the use of the flotation process spread to the cement industry and has since found wide use as a method to correct improper lime-alumina-silica-magnesia ratios by subtracting or adding portions of one or more of the ingredients.

Flotation then began to encroach

upon an already established chemical process—that of recovering potash salts from impure ores. Within the past fifteen years froth flotation has invaded fields other than the mineral industry and resulted in new and unusual separation processes. In several of the newer applications flotation is now being used simply to remove solid phase material from a liquid phase, supplanting thickening operations. It has been found that in these applications flotation could successfully recover particles of near-colloidal size where combination thickening-filtration methods were entirely impracticable and commercially impossible.

For many years flotation and concentration of ore were inseparable and the flotation process was developed strictly for use in the mineral industry. The old concept that flotation must involve the selective separation of one solid phase from other solid phases was closely adhered to until recent years. The expanding use of flotation principles in the chemical, food, and process industries may be attributed to (1) increased publicity and understanding in general of flotation as a separatory process, (2) the "by chance" use of flotation where all other commonly known separation processes have failed, (3) increased demands upon all industries that wastes be adequately treated before disposal, and (4) economic demands upon separation operations resulting in a more thorough search of available processes of possible application to specific problems of industries not closely allied to the mining field.

Technical Status

While some progress has been made in changing flotation from the status of an art to a science, many problems are as yet unsolved. In spite of these vagaries, flotation is finding new uses in diverse fields.

The flotation of di-lithium-mono-sodium phosphate from the highly alkaline brines of Searles Lake in California[1,2] is an excellent example of a process where flotation principles were used to solve a difficult separation problem and is now a commercial success. All other chemical separation processes which were considered for this separation operation were commercial failures. In this application, an extremely simple flotation process makes an almost perfect separation of near-colloidal sized particles from a saturated brine. The lithia content of the brine entering the flotation plant is less than 0.05 percent, and this solid phase is concentrated to a high grade concentrate containing over 20 percent lithia. The application of flotation principles to the clarification of liquors containing greases, gums, and fats offers much as a separatory process.

Sizing

Flotation also has many possibilities as a sizing operation, especially in the near-colloidal size range. The fractionation of fine clays[3] has been accomplished by flotation. In fractionating clay by flotation it has been found possible to obtain a series of accurately sized concentrates from one installation of flotation cells operated in series. Similar results have been obtained in the flotation of metallic ores.

The common conception of the floatability of metallic ores is that floatability increases in a direct proportion to the fineness of the ore up to a certain point and then decreases. This conception may be a shortcoming of the type of flotation cell used since it has been demonstrated[1,2,3] that the flotation of extremely fine-sized particles requires different flotation conditions than coarser particles. For example, the usual mechanically-agitated flotation cell may be suitable for the recovery of ore particles as fine as 20 to 40 microns, but exhibits a loss in efficiency when floating particles in the range of 2 to 10 microns. The same ore when placed in a pneumatic-type cell capable of generating very fine sized bubbles under relatively quiescent conditions may demonstrate poor flotation of the particles coarser than 20 microns but shows excellent results on particles in the 2 to 10 micron range. Thus a combination of pneumatic and mechanical flotation cells may be desirable when flotation is used as a sizing operation. The ceramic and chemical industries are becoming increasingly interested in the use of extremely fine sized and accurately graded raw materials. Fractionation of fine sized salts and chemicals by dry methods is costly in many cases. When large tonnages are involved, flotation may offer a more efficient sizing method.

Fossil Resin

Recently the recovery of fossil resin from Utah coal by flotation was proven a definite commercial possibility.[4] In this process bituminous coals containing 5 to 7 percent by weight of fossil resin were treated in pneumatic cells to produce a resin concentrate in the froth and an improved coal product as the flotation underflow or tailings. The fossil resin concentrate was then refined by chemical methods involving leaching, clarification of pregnant liquors, partial distillation and recovery of the solvent, and melting of the final purified resin into suitable shipping form.

A very unusual application of the flotation process has been reported from Australia.[5] This development involved the separation of ergot from rye by flotation. Ergot is a dark-colored fungus which replaces rye grains when this cereal is affected by this particular fungus disease. The individual grains of ergot are black, compact and similar in shape to rye grains. Ergot contains several alkaloids which are important medicinally. Prior to World War II the chief source of this drug was continental Europe. In Europe the separation of ergot from rye was usually accomplished by hand-picking, heavy density separation using a brine solution, or by the unique method of feeding the crop to fowls which eat the grain leaving an ergot concentrate. Shortcomings of the European methods led to the development of a flotation method which successfully concentrated the ergot by removing the rye grains in the froth product and recovering a high-grade ergot concentrate in the underflow. This was possible since the ergot surface was much less hydrophobic than that of rye and by selectively coating the rye with a paraffin it was easily floated when the pulp was aerated in a pneumatic-type flotation cell.

Cleaning Peas and Wheat

A similar flotation development is in use in the state of Washington where vined canning peas are cleaned by froth flotation.[6] In this operation the peas are wetted with a purified mineral oil and selectively removed from the pulp. The removal of hulls and impurities from wheat by froth flotation is also common practice.

Another interesting development is a report on water purification by flotation.[7] Several samples of domestic waters were treated by a froth flotation process resulting in an average reduction in turbidity of approximately 70 percent and a reduction of bacterial count of 90 percent. Processes such as the latter give indications that the fineness of particle size susceptible to flotation treatment is almost infinite.

The principal raw materials of the chemical industry are minerals, both metallic and non-metallic. Modern chemical and mineral engineers realize how much the chemical and mineral industries have in common and how much they depend on one another. With the continued depletion of chemical raw materials even closer cooperation will be necessary if the

problems of adequate raw material supplies are to be solved. The technical interdependence of the two industries becomes apparent when a study is made of some of the combined unit operations and unit processes now used successfully to recover metals or metallic compounds from ores.

The tungsten concentrator of the Nevada-Massachusetts Co. located near Mill City, Nev., is an interesting example[6] of an operation involving flotation, gravity separation, roasting, magnetic separation and chemical treatment. The crude ore processed in this plant contains only 0.25 to 3 percent tungstic oxide and the final concentrate contains over 75 percent tungstic oxide. During World War II a government plant at Fredericktown, Mo., treated a low-grade ore by flotation to produce a nickel-cobalt concentrate which was treated chemically to separate the nickel and cobalt.

With the rapid progress being shown in the development of new applications of adsorption as a unit operation, it seems possible that flotation will be called upon to separate extremely fine sized adsorbents and their adsorbed materials from ore pulps and other mixtures. The solid adsorbents could then be treated to free the adsorbed materials and the adsorbents returned to the system. The Chapman process of recovering gold using activated carbon demonstrated these possibilities several years ago. It has been shown[9] that chromium, iron, molybdenum, palladium and vanadium can be adsorbed from solutions as complex anions and recovered. Copper has been recovered from cuprammonium rayon waste liquors[10] by use of cation exchange. Removal of copper from gasoline by a cation exchange method is also patented.[11] Study regarding the use of the many new ion exchange materials in flotation pulps may reveal answers to problems concerned with the effects of specific ions in flotation-pulps since various ions can now be added or removed at will.

The non-metallics are becoming increasingly important as chemical raw materials. Some of the non-metallics commercially processed by froth flotation are glass sand, clay, potash salts, barite, fluorspar, feldspar, mica, cement rock, kyanite, garnet, talc, and phosphate rock.

Industrial Wastes

As the industrial activities of a nation increase, it is only natural that waste disposal problems increase commensurately. The annual loss of minerals and chemicals as waste products amounts to many millions of dollars. In addition to monetary loss there is also presented the problem of the pollution of water courses. The importance of this problem is evident when it is noted that during the past fifty years more than one hundred bills relating to federal control of stream pollution have been introduced into Congress. In many cases, these industrial wastes are as complex as the products that come from the industries that produce them. A few of the waste materials awaiting more efficient recovery processes are cannery wastes, oils and greases from machine operations and the meat packing industry, acid wastes from coal mine drainage, steel mill and petroleum refining process waste, dairy wastes, all types of dust wastes,[1] waste fibers from paper mills and cloth finishing plants, distillery wastes, and the multitude of complex wastes from organic chemical processes.

As in the mineral separation industry, many of the waste disposal problems of the chemical industry involve the recovery or removal of a solid phase material from a liquid. While in the past there has been some application of mineral separation processes to the recovery of valuable products from industrial wastes, there are still many opportunities awaiting the mineral and chemical engineers who make use of the possibilities offered by new and improved applications of already established separation operations. The froth flotation process has much to offer in the purification of industrial waste waters and sludges. In addition to removal of fine sized particles from waste waters, flotation also has the added advantage of decreasing the bio-chemical oxygen demand (B.O.D.) of these waste waters. There are instances in several types of waste disposal plants where liquors are aerated, at considerable expense, for the sole purpose of lowering the B.O.D. of these liquors. By accomplishing this same purpose in flotation cells, suspended solids which are normally filtered or settled out in huge basins can also be removed by combining these two distinct operations into one.

In a few instances flotation has been thoroughly investigated as a possible process for recovery of fine solids from waste liquors. These investigations have resulted in processes for the treatment of white water in the paper industry,[13] purification of coolants, recovery of waste porcelain enamel,[12] purification of rayon spin bath,[14] recovery of minute synthetic rubber particles, and water and sewage treatment processes. In these examples it should be noted that the liquid phase is not always water as is the case in flotation processes of the mineral industries. Much original work remains to be done on the application of flotation to processing liquids and liquid wastes in which the solids are carried in mineral oils, organic liquids, brines, and water containing high concentrations of dissolved impurities and other contaminants.

Cost Problems

One factor which may be influential in retarding the development of flotation processes for treating industrial wastes is the apparent high cost of flotation operations in the mineral industry. In most cases, extrapolation from existing flotation operations will not give the true cost of flotation as a waste-treatment process. In handling large volumes of liquid wastes it will be possible to use flotation cells of simple design since many of the problems associated with heavy ore pulps will not be encountered. Most industrial wastes which could be treated by flotation are extremely dilute pulps containing very slow settling solids which can be recovered in very large flotation cells which at present are not used in the mineral industry.

The chemical industry can expect new and unique applications of flotation in the solution of problems involving the recovery of solid phases from liquids, classification of near-colloidal sized particles, and the selective recovery of one solid phase from another in aqueous and organic liquid pulps. Increased use of the flotation process by the chemical industry may also result in improvements applicable to existing flotation processes in the mineral industry. The benefits to be derived from mutual cooperation in further development and application of the flotation process are great and should not be overlooked by the chemical and mineral industries.

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Check these opportunities for improvement—or error →

PLANT LAYOUT Gravity flow can be carried too far; high buildings are expensive buildings.

SOLIDS HANDLING Palletizing and bulk handling could be used more widely; both cut time and costs.

LIQUIDS HANDLING For flammable liquids, an ounce of precaution is worth a pound of insurance.

SMALL-LOT STORAGE The stock clerk could make up more orders if he had a few mechanical aids.

FORCED VENTILATION Fresh air saves money; workers get less done in hot stuffy buildings.

CENTRALIZED MANUFACTURE Modernizing several old plants often costs more than a big new central factory—and you still lack big-plant efficiency.

WAREHOUSE DESIGN For fast movement of goods: a non-congested neighborhood, non-congested aisles.

MACHINE ACCOUNTING Punch card accounting is catching on, especially in inventory control.

PRODUCTION CONTROL Many plants still schedule work haphazardly; it should be a full time job.

When You Modernize Your Plant

Two sharp-eyed engineers went through a dozen old plants looking for "anything that could stand improving." They've come up with ideas aplenty.

Walter W. Slocum
Consulting Engineer, New York, N. Y.

Gregory M. Dexter
Consulting Engineer, Newark, N. J.

MANUFACTURERS in the chemical industry should take advantage of these peak-sales years for completion of modernization and cost-reduction programs. Rising labor and material prices, coupled in many instances with obsolescent plants, have awakened interest in the savings possible through revised plant layout, modern material-handling methods, and improved process methods and equipment. Substantial economies in space utilization, and reductions in fixed and operating charges are possible through an engineering design for low unit-cost construction and production.

For the purpose of examining these elements in a modernization program it is useful to have a specific example; discussion can then be in more particular and less general terms. The paint industry makes a good vehicle for the purpose: (1) It presents a diversity of problems and opportunities—from plant layout down through each item in the checklist above; (2) its problems are typical and can be found in many kinds of chemical plant; in most of the cases to be cited, the reader, where we speak of paint or pigment, can substitute the name of his own product; and (3) an extensive study of paint plants in the east and midwest reveals important opportunities for improvement.

PLANT LAYOUT

The paint industry, like many others, turns out a large variety of products in numerous sizes of container. Although the bulk of production of any one factory is usually found in a small variety of paints, in a few colors, and in about three or four sizes of container, the remainder of the output is in numerous small amounts, varieties, colors, and containers.

An occasional paint factory produces only a few varieties of paint, in large quantities. It can use advantageously a single-story building with perhaps a mezzanine floor. The flow of paint, instead of being due to gravity, will in general be by pumping. Such factory is the cheapest obtainable, as all finished and raw goods can be stored generally on a 5-in., reinforced-concrete pad on the ground. Their loads do not have to be transferred to the ground through columns as is necessary in multi-story paint factories. A one-story building with fire walls, sprinklers, and good electric lighting might cost $5-6 per sq. ft. if the cheaper types of construction are used, as compared with $10-12 per sq. ft. for the multi-story building. Manufacturing equipment is not included in the unit costs.

The usual paint manufacturer, however, with his small quantities and various-sized containers, finds it more convenient to discharge paint from mills into buggies. The buggies are then pushed over holes in the floor for discharge into filling tanks below. Such manufacturer can approach his factory design in three ways:

(1) *Hillside Location*—First, he can get a sloping hillside on which to locate the factory. The raw material and pigments can then be stored in a one-story, low-cost warehouse. The floor of such warehouse should be as nearly as possible on the same level with the mixer floor of the paint factory. The latter could be a three-story building with the mixers on the third or top floor, the grinders on the second floor, and the filling tanks with can-filling and cartoon-filling line on the ground

floor. The finished goods should move from the filling line into a one-story, low-cost warehouse.

The final factory might consist of 60,000 sq. ft. of warehouse at $5-6 per sq. ft., and 30,000 sq. ft. per floor for the manufacturing area, or 90,000 sq. ft. at $10-12 per sq. ft. These costs should include fire walls, sprinklers, and electric lighting. The cost for 150,000 sq. ft. might be $1,200,000 to $1,440,000. In contrast, a three-story building of 150,000 sq. ft. might cost $1,500,000 to $1,800,000. To these costs would have to be added various items such as elevated tank for fire protection, doors on shipping and receiving platforms, railroad trackage, sewers, power distribution, heating, forced ventilation, and similar items not generally included in building costs. The differential in cost between the two types of building will be increased by the operating and capital costs of freight elevators needed for the usual multi-story building.

(2) *Level Site*—If a sloping site cannot be found a level site might be used. The incoming railroad track for raw material should be raised on a trestle or dirt embankment to serve a one-story, low-cost warehouse on a rolled embankment. The outgoing railroad track should be depressed in order to get as much difference in elevation as possible for gravity flow. The manufacturing area could be made only two stories high with the mixers on the top floor and the grinders on the ground floor. The buggies of paint could be raised by skip hoists to a small mezzanine platform over the filling tanks in the one-story, finished-goods warehouse.

This two-story manufacturing plant and its two warehouses should cost about the same as the three-story plant and two warehouses on a sloping site. Neither needs freight elevators. Two small passenger elevators should be ample. Ramps for the occasional movement of lift trucks between floor levels should be provided. In both layouts, raw material and finished goods should move on lift trucks with pallets to and from the manufacturing areas. Raw material in the manufacturing areas should flow by gravity from mixers to grinders and from filling tanks to cans.

A two-story manufacturing building with mezzanine for filling tanks and two one-story extensions should cost considerably less than a three-story, storage-and-manufacturing building without warehouses. There should be no increase in operating cost for labor if the buggies of paint are raised to a mezzanine floor over the filling tanks, provided pushbutton controlled skip hoists are used. Electric power is cheap!

Paint manufacturers in their insistence on complete gravity flow are overlooking the excessive construction costs in multi-story construction as compared with single or two-story construction. Keep your loads as close to the ground as possible and reduce your building costs!

Engineers generally consider that each additional floor in a building adds about 5 percent to the sq. ft. cost. If the top floor in a three to five-story building carries a dead load of 400 lb. per sq. ft. from bags of pigment the increase is even more.

(3) *Expensive Site*—If ground space is at a premium and railroad tracks cannot be elevated and depressed, then the alternate to the preceding layouts is a three-story building with freight elevators, and two one-story wings as warehouses. Such design means higher capital costs and, due to the use of freight elevators, increased operating costs. Few executives appreciate the losses in effective working time by employees moving raw material up in elevators for gravity flow, or by executive employees waiting to ride on elevators. Freight elevators in several paint factories were found to be too slow and too small as to floor area and net safe load.

SOLIDS HANDLING

Palletizing—The use of pallets for storing bags of pigment or cartons of finished goods will be found to reduce the excessive handling costs in many paint factories. Bags and cartons are often rehandled several times where pallets are not used and where space for storage is cramped. Emplovees will be found more efficient when provided with pallets and electric or gasoline lift trucks. Thev will waste less time smoking in the lavatory and will not dawdle from being tired due to excessive walking.

Pallets can be leased from a central pool or provided by the paint manufacturer so pigments can be shipped in bags on pallets to the paint factory. The bags can be left on the pallets until the pigments have been used. Cost of handling should thereby be reduced.

Some paint manufacturers with large shipments to some customers can even use those pallets for the movement of some finished goods before the pallets are returned to the central pool or to the paint factory.

Bulk Handling—A few manufacturers of pigment are using air ducts to handle their product. They will ship their pigment in freight cars in bulk. Most pigment however, is shipped in bags, as they offer a ready means to paint manufacturers of measuring quantities put into the mixers. Where a paint manufacturer is making large quantities of only a few kinds of paint, the possible use of bulk handling should not be overlooked. The paint and pigment industry has much to learn from other industries as to the possibilities of bulk handling of powders. The principal objection to bulk handling is the small quantity of any one variety of paint made by the usual manufacturer.

LIQUIDS HANDLING

The pumping of vehicles and solvents is increasingly common. Storage of them outside of the paint factory is desirable in order to reduce the fire hazard. Automatic controls on the pumps may be used, with meters on the discharge lines in order to measure the quantities of vehicles and solvents. Smaller quantities may be weighed into buggies on floor scales from overhead discharge lines. Even smaller quantities can be taken by quart or gallon measure from drums on floor racks. In the latter case, a separate brickwall-enclosed room is desirable in order to keep fire-insurance costs low.

Surprisingly enough to the uninitiated is the low-cost fire insurance that is possible with a properly-designed paint factory. Solvents and vehicles, except for a few drums, are stored outside the factory. Fire walls with fire doors are used to break up large, one-floor areas into sections. Unprotected steel columns may be used in the warehouses although concrete-protected columns will be required in the manufacturing areas. Sprinklers will be required in the manufacturing and warehouse areas.

Paint factories acceptable for fire insurance to the Associated Factory Mutuals or to the Factory Insurance Association can be built without paying too great a premium in capital cost.

SMALL-LOT STORAGE

One of the expensive nuisances of the paint factory is storage in bins of small lots of every color and variety of paint made, in all the various-sized containers. Orders for one or two cans of this or that quantity, color, and variety are drawn from these bins.

Here, again, excessive costs are in-

curred due to poorly lighted bins and aisles between bins. The picker works slowly not only because of poor light but also because of the excessive walking required. A time study of the picker's work would be revealing to most paint executives.

One method of reducing the walking would be to provide a trolley along the aisles between the bins. Several small platforms could be suspended therefrom on which to place cans of paint. Below each platform a step could be provided on which the picker could ride as on a child's scooter. Such an installation might cost $10,000. Interest and depreciation thereon might amount to $1,000 and maintenance would be almost negligible. With a picker earning $2,500 to $3,000 yearly, not much saving in his time or increase in the speed of his work is needed to justify the capital expenditure required.

FORCED VENTILATION

A good argument can be made for providing a paint factory with forced ventilation in order to remove objectionable odors and vapors. Employees will work better in fresh air. There does not appear to be any valid argument for complete humidification control in a paint factory, as there is in a textile or tobacco plant; frequently, however, it would definitely pay to go as far as forced ventilation. In many a warehouse more work would get done of a hot summer afternoon if a breath of air were stirring.

CENTRALIZED MANUFACTURE

An interesting study for some manufacturers would be the possibility of replacing several small factories, located in various cities, by one large factory in a central location to serve warehouses in those cities. Several obsolete paint factories could be replaced by one large modern factory. The capital investment required should be less than modernizing several factories. Overhead costs should be reduced by operating the central factory 24 hr. daily.

A coordinated service involving the use of teletype orders from the warehouses twice daily, at noon and late in the afternoon of each day, would be necessary. Truck shipments from the central manufacturing plant might be necessary not later than midnight of the same day. Railroads are now offering fast (often overnight) freight service. Production and inventory control of a high order would be necessary. Shipments could be made on pallets from the central factory to the warehouses in order to cut down rehandling.

The central paint factory could be located in a small community where building costs could easily be 10 percent less than in any one of various large cities. Wage rates might also be less. Manufacturing runs on different varieties of paint could be of a day's duration or more with consequent reduction in labor cost as compared with short runs in the various small factories. The use of heavy-duty production equipment and pumps on at least some varieties of paints and the bulk handling of some pigments should be possible.

Location of a paint factory in the outskirts of a large city in many cases will assure a better grade of employee. Advantage could be taken of a larger site, that would be possible with cheaper land, to provide recreational facilities and better living and working conditions for employees. The troublesome parking problem for employees' automobiles would also be solved.

Other possible minor improvements include automatic cleaning and washing machine for paint buggies, enclosed pit for burning refuse, vacuum system for cleaning floors, and semiautomatic equipment for mixing powders and filling packages.

PRODUCTION CONTROL

The idea that all pigment used in a paint factory must be stored on the same floor with the mixers, and immediately adjacent thereto, is outmoded. Some pigment that is used in small quantities might be stored to advantage. Larger quantities, however, should be delivered on pallets by lift trucks under production-control methods.

Work should be scheduled by a production-control manager and its sequence not left to a foreman or superintendent. The work to be done on a given day should be known the night before except for the occasional exception of an emergency order. Such orders should require the approval of the factory manager before fabrication is started as they increase operating costs. The paint industry in general does not appear to have a good understanding of the possibilities of production and inventory control. This situation is due in part to the necessity in some paint factories of manufacturing for stock in order to meet the peak demand in spring and fall.

Salesmen for a paint manufacturer should be required to make an estimate every month of demands for various kinds of paint in the following month. A summary of these estimates will eliminate many of the vagaries in the individual estimates. Prizes might be offered to the salesmen coming closest to their estimates. The monthly summary will be of great help to the production manager in setting up required inventories and production schedules. Every inventory, of course, should be governed by maximum and minimum quantities that have the approval of the plant's management.

WAREHOUSE DESIGN

An investigation of delays in deliveries and shipments of paint to and from warehouses might show them to be expensive. A warehouse located on the fringe of a city, and not in the congested downtown district, could lead to lower trucking costs. Highway and railroad connections available for incoming material would have to be studied in relation to the city's through streets and expressways. Each city will have its own special problems in locating a warehouse or factory such as cost of land, foundation conditions, available entry to and exit from the site, and available labor supply and its quality.

Shipping and receiving platforms at many paint factories are too narrow for ease in handling shipments. The use of enclosures for trucks or railroad cars and platforms will not greatly increase the cost of the warehouses. Cold climates make such enclosures desirable by increasing the speed of work in mean weather.

MACHINE ACCOUNTING

Several paint manufacturers have installed, in whole or in part, machine accounting. It is particularly advantageous for inventory control of numerous items as in a paint factory. It can of course be carried over into other accounting functions.

The day is probably not far distant when orders coming over the teletype machine to a paint factory from a warehouse will be automatically transferred to punch cards for machine accounting.

One chain grocery-store warehouse with its machine accounting reports each morning at nine o'clock the exact status of its inventory as of the preceding midnight. A similar procedure in a paint factory would be of great help in production and inventory control where centralized manufacturing is possible.

Vacuum

Edward Ledoux
Attapulgus Clay Co.
Philadelphia, Pa.

Concentration Methods

GOOD: Single effect concentration apparatus utilizes one evaporator, a condenser and a vacuum pump.

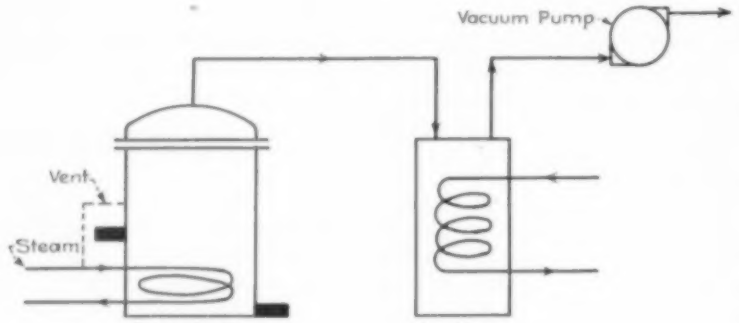


Fig. 1

BETTER: Double effect system reduces cost for same capacity by more efficient use of heat supplied.

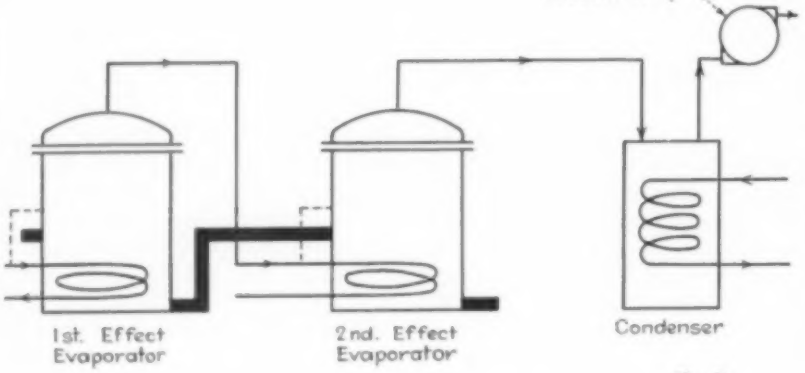


Fig. 2

BEST: Replacing condenser with adsorber permits operation at lower temperature using same power.

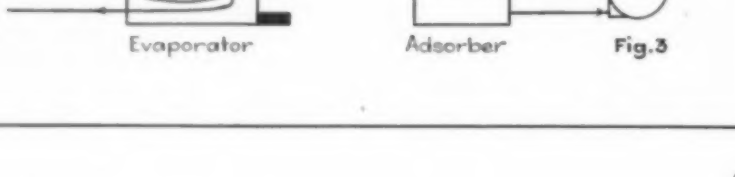


Fig. 3

FOR INDUSTRIAL applications, vacuum concentration and drying has four major advantages. These are: (1) Lower boiling points of solutions which create larger temperature differences between the material and source of heat supply. (2) Higher heat transfer coefficients at evaporators and condensers when removal of air (or other non-condensable gases) prevents formation of insulating films of near stationary gases on transfer surfaces. (3) Lower operating temperatures which permit distillation of mixtures that would decompose if heated to the boiling point at atmospheric pressure. (4) Air removal prevents oxidation of substances being treated.

Since the operating pressure is below atmospheric, vapor must be pumped out, but it must first be condensed before removal to reduce the work required. The general arrangement of a single effect apparatus is shown in Fig. 1. In the multiple effect system shown in Fig. 2, the condensation of vapor liberated in one effect is used to heat the following effect: the last effect is connected to the condenser. Each effect must of course operate under a greater vacuum than the preceding one since the boiling temperature must be lower than the condensation temperature of the vapor from the preceding effect. The advantage of the multiple effect system is not increased capacity but a reduction in operating cost through more efficient use of the heat supplied: also, the work of the condenser decreases when the number of effects increases since it has to handle only the vapor liberated by the last effect.[4]

Whatever the number of effects, the lowest temperature at which a liquid can boil depends upon the vacuum in the condenser and, for a given expenditure of power at the vacuum pump, this is limited by the vapor pressure in the condenser and therefore the temperature of the available cooling water. Since the vapor pressure of adsorbents is lower than that of free liquid at the same temperature, replacing the condenser by a cooled adsorber, Fig. 3, will permit operation at even lower temperature. This is the purpose of adsorption drying or concen-

Concentration by Adsorption

tration and, figuratively speaking, it comes to filling the condenser with adsorbent.

Consider the single effect concentration of an 87 percent solution to 98 percent. The maximum temperature at which the solution can be heated is 20 deg. C. The adsorber is maintained, by proper cooling, at 22 deg. C. The mixture to be concentrated is characterized by its isosteres shown in Fig. 4; the initial portion of the 22 deg. C. equilibrium isotherm of the adsorbent is also shown in Fig. 4.

The concentration c′ in the adsorbent being expressed in grams of water per gram of adsorbent dry basis, the concentration of the solution must be expressed in the same manner. Thus, on a dry weight basis, the objective is to concentrate the solution from $c_1 = 1/0.87 - 1 = 0.15$ to $c_2 = 1/0.98 - 1 = 0.02$. Note that, when the concentration on the basis of weight of solution increases, the dry weight concentration decreases.

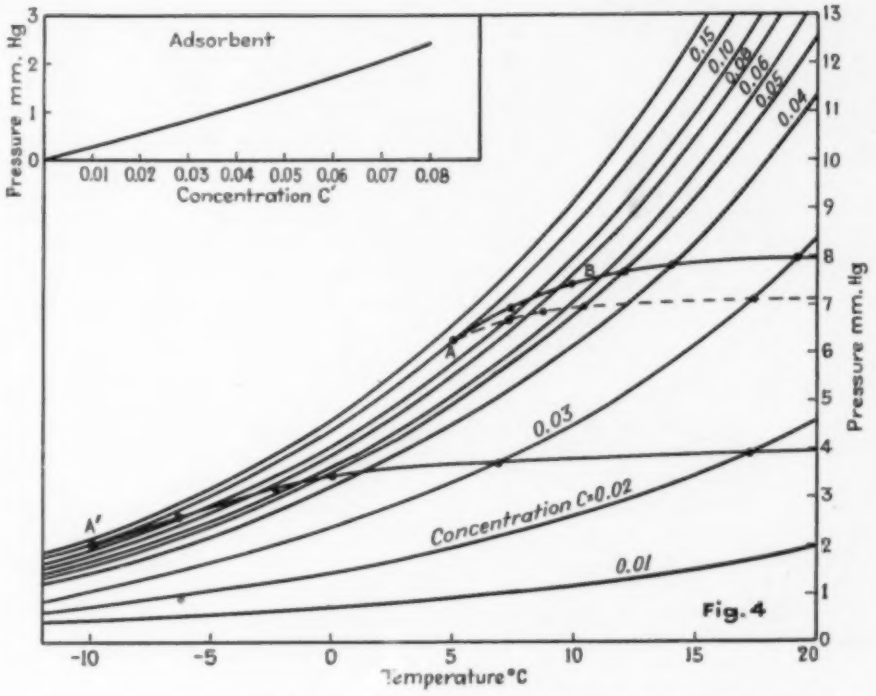
First will be considered operation starting under a 753.75 mm. Hg vacuum using a ratio $m'/m = 2$ between weight of adsorbent and weight of solid in solution. The total pressure in the system at the start will be 760 − 753.75 = 6.25 mm. Hg. Assuming that the depth of solution in the evaporator is small, the liquid will be under this absolute pressure. Fig. 4 shows that, at this pressure and a concentration of 0.15, the boiling point of the solution is 5 deg. C. (point A) and this is the temperature assumed by the solution at the start. If the amount of solution is large, its depth may be appreciable and the average hydrostatic pressure should be added to the 6.25 mm. Hg for the determination of the boiling point.

As operation proceeds, the boiling point, and therefore the temperature of solution, increases due to the fact that its concentration c decreases while the vapor pressure of the adsorbent increases causing a rise in total pressure. The problem consists in plotting, on Fig. 4, the boiling point curve of the solution.

Neglecting the small amount of vapor eliminated from the system by the vacuum pump and, expressing that the loss in weight of the solution is equal to the gain in weight of the adsorbent, we have

$$m\,(c_1 - c_2) = m'c'$$

This relation determines the concentration c of the solution for any given concentration c′ in the adsorbent. The vapor pressure p′ corresponding to c′ is given by the isotherm of the adsorbent and the total pressure, which determines the boiling point, is p′ + 6.25. For instance, for c′ = 0.04, p′ = 1.15, and, from the above equation, c = 0.15 − 2 x 0.04 = 0.07. The total pressure is 1.15 + 6.25 = 7.40. For this pressure and c = 0.07, the boiling point is 9.8 deg. (point B).



A mixture has characteristic isosteres. Along with a plot of them is shown the initial portion of a 22 deg. C. equilibrium isotherm of the adsorbent.

Vapor Pressure

Strictly speaking, the vapor pressure in the adsorber is slightly higher than the equilibrium pressure p′ of the adsorbent due to the resistance to diffusion inside the granules.[3,5] However, since we have, on the other hand, neglected the vapor evacuated by the pump, the concentration in the adsorbent is somewhat lower than that calculated so that, for practical purposes, the difference in vapor pressure need not be taken into account.

Other points of the boiling point curve are obtained in the same manner and the curve is shown in continuous line in Fig. 4. Since, for c′ = 0.075 (p′ = 2.20), c = 0, the curve is asymptotic to the horizontal 2.20 + 6.25 = 8.45 mm. It will be observed that, when the concentration is 0.03, the temperature of the solution is 18.2 deg. C. and that a concentration of 0.02 cannot be reached without exceeding the limit temperature of 20 deg. C. Operation must therefore be carried out at lower initial temperature: this requires a greater initial vacuum.

If the vacuum is increased to 758 mm., the total pressure at the start will be 2 mm. resulting in an initial temperature of − 10 deg. C. (point A′). Note that, although this temperature is lower than 0 deg. C. the solution will not freeze because the pressure of 2 mm. is lower than the sublimation pressure at that temperature. The boiling point curve for 758 mm., determined in the same manner as the previous one, is shown in Fig. 4: the asymptote is 2.20 + 2 = 4.20 mm. The maximum temperature of the solution, which exists when the concentration is 0.02, is seen to be 16.6 deg. C. which is satisfactory. The final concentration in the adsorbent will be $c'_2 = 0.5\ (0.15 - 0.02) = 0.065$ that is to say 6.5 percent by weight.

So as to find out the effect of an increase in the amount of adsorbent, operation at 753.75 mm. vacuum and a weight ratio of 4/1 will now be con-

sidered. The initial point of the boiling point curve is of course the same as in the previous case at the same vacuum. The rest of the curve, calculated in the same manner as before, is shown in dashed line in Fig. 4. It is lower but not much so. If the amount of adsorbent were infinite, its vapor pressure would not increase and the total pressure in the system would remain equal to 6.25 mm. The boiling point curve would be the horizontal from point A. This isobar of the solution determines the limit of possible reduction in temperature which can be achieved by increasing the amount of adsorbent. It will be apparent that this means is considerably less effective than increasing the vacuum. In fact, for a given weight ratio, the curve may be made to coincide with the isobar by progressively increasing the rate of evacuation to compensate for the rise in vapor pressure of the adsorbent.

Of course, if it is possible to cool the adsorber down to a lower temperature than 22 deg. C., there is advantage in doing so because then the equilibrium isotherm of the adsorbent is lower, increase in operating pressure is reduced and thus the temperature of the solution. The lowest possible boiling curve obtainable by cooling the adsorber is the isobar. On the other hand, if the adsorber were not cooled at all, its temperature would rise considerably due to liberation of the heat of adsorption and the isotherm would become progressively much higher.

Evaporator Heat Supply

The latent heat of desorption must be supplied to the evaporator to keep the solution boiling and the process in effective operation. This latent heat is equal to the normal heat of vaporization plus the net heat: it is a function of both temperature and concentration which is characteristic of the nature of the solution considered and it may be calculated from the isosteres.[1,5] The rate at which the heat is supplied determines the rate of vaporization and therefore controls the capacity of the apparatus. This rate is a direct function of the difference between the temperature of the source of supply and that of the solution. Thus, if the former remains constant, the capacity decreases as operation proceeds because the temperature of the solution rises.

Consider for instance operation at 758 mm., the room temperature being 11 deg. C. Since initial temperature of the solution is −10 deg. C., operation could be started without any actual heating, the latent heat of desorption being provided by the surroundings under the temperature difference $11 - (-10) = 21$ deg. C. However, this temperature difference, which is already very small, would decrease rapidly as well as the activity of boiling and the capacity. When the solution had reached 11 deg. C., that is to say a concentration of 0.025, no more heat would flow from the surroundings and boiling would cease. Operation would not stop completely however because, the vapor pressure in the adsorber still being lower than that of the solution, evaporation would continue, the necessary heat of desorption being supplied by the solution itself. This would cause the temperature of the solution to drop below its boiling point and the evolution of vapor would be due to surface evaporation only; a much slower process than boiling. By reason of the gradual decrease in capacity described above, the heating of the solution should be increased progressively whenever practicable. Note that the amount of heat to be supplied per unit weight of vapor evolved increases gradually because the latent heat of desorption increases as the dry weight concentration decreases. Note also that the temperature of the solution is determined by the working absolute pressure and not by the temperature of the source of supply. Inspection of Fig. 4 shows that operation at less than 1 mm. absolute pressure will permit boiling at very low temperature but, to hold such low pressures, the weight ratio m'/m must be increased or the isotherm must be lowered by refrigeration or both.

The capacity of the apparatus depends also upon the rate of transfer of vapor to the adsorbent. Thus, there is advantage in using a reasonably fine mesh size since the exposed surface increases as the particles become smaller. Of course, the rate of transfer increases with the weight ratio m'/m.

In the case discussed previously, the nature of the material treated was such that the total amount of liquid to be removed by adsorption was not too great. Materials from which much liquid is to be removed should be treated by multiple effect. Then, the adsorber would have to handle only the small amount of vapor in the last effect. Alternatively, the material may be partially pre-dried at low temperature by forced draft of dry air or other gas.[1,2]

Since the basic principle of the process described is to condense at a vapor pressure lower than the normal one at the temperature attainable with the available cooling water, it would be theoretically possible to obtain similar results by other means: for instance by the use of chemicals, sulphuric acid, solid chloride hydrates, chloride solutions, glycerine, diethylene glycol, etc. However, these products do not, like good commercial granular adsorbents, possess, individually, all the following characteristics which are essential to practical industrial scale operation: (1) high concentration vaue at low vapor pressure at practical cooling temperatures, (2) possibility of easy and economical regeneration *in situ* (3) large surface of transfer, (4) physical and chemical stability, (5) non-corrosiveness, (6) no partial pressure of its own, (7) low cost.

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Farben Process for Lower Vinyl Ethers*

MANUFACTURE of lower vinyl ethers by pressure reacting acetylene and alcohols is a major industrial application of Reppe acetylene chemistry developed by I. G. Farbenindustrie. Since lower vinyl ethers can be hydrolized to give alcohol and aldehyde, this process offers the possibility of producing acetaldehyde without using mercury or complicated catalysts.

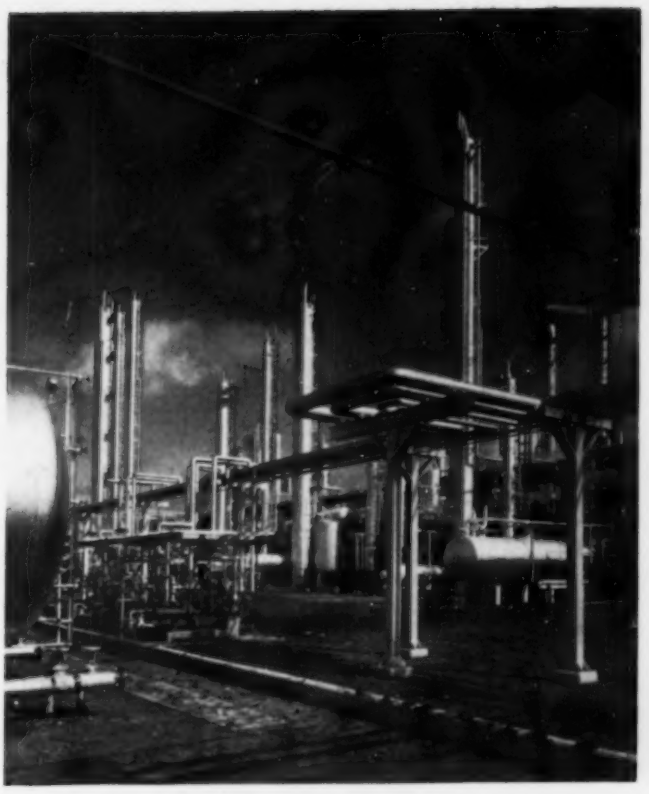
The reaction of acetylene with one of the lower boiling aliphatic alcohols is exothermic. It may be conducted in the liquid phase using potassium hydroxide dissolved in the respective alcohol as a catalyst. Reaction proceeds continuously in reaction towers at temperatures varying from 150-165 deg. C. and at pressures from 4 to 22 atm. depending on the alcohol used.

Preparation of the lower vinyl ethers is performed in two steps. First is the manufacture of the so-called "distilled" vinyl ethers containing 90-95 percent vinyl ether and 5-10 percent alcohol. Although not suitable for polymerization purposes, they can be used for conversion to acetaldehyde.

Second step is the manufacture of "distilled" vinyl ethers of purity suitable for polymerization.

* PB-97606, "The Lower Vinyl Ethers and Their Use for Acetaldehyde Manufacture," OTS, Department of Commerce.

Clarkwood research and . . .



. . . Bishop towers spell . . .

Chemcel Petrochemicals

J. V. Hightower
Southwestern Editor
Chemical Engineering

RAPID growth, since 1945, of the Bishop, Tex., plant of the Chemical Division of Celanese Corp. of America symbolizes the remarkable expansion of the petrochemicals industry in recent years. Today the Bishop plant—Chemcel is its name—is one of the leading manufacturers of chemicals from petroleum raw materials. Chemcel makes chemicals by the controlled oxidation of hydrocarbons.

The plant is still growing. An important factor in its vitality is the Chemical Division's Petroleum Research Center at Clarkwood, about 25 mi. crow-flight distance from Bishop. Clarkwood's organization and pilot plant equipment are described below.

Production of chemicals at Bishop increased substantially last year. New units for manufacture of isopropyl alcohol, n-propyl alcohol and butyl alcohols came into operation. The 1948 prospect is for further expansion through improved operation of existing facilities and raw materials. Celanese says that several new chemicals are scheduled this year as a result of development work at Clarkwood.

Today, the Bishop property covers some 500 acres near Corpus Christi on the lower Texas Gulf Coast, a locality with enormous natural gas reserves. Estimates of the total plant investment range between $20 and $25 million. Chemcel employs around 900. This includes a technological staff of about 60, of which 25 are chemical engineers and 15 are chemists.

Chemcel produces, at present, the following finished chemicals: acetic acid, acetaldehyde, acetone, butyl alcohols, formaldehyde, isopropyl alcohol, methylal, methanol and n-propyl alcohol. Of all the chemicals manufactured by Celanese, only one, tricresyl phosphate, a plasticizer, which is produced at the Celanese plant at Newark, N. J., is not made at Bishop. All these chemicals, including acetic acid and acetone, are sold on the open market by Celanese. Of the Bishop chemicals, only acetic acid and acetone move to company plants at Cumberland, Md., and Narrows, Va., to produce cellulose acetate.

Idea for Plant

When considering going into the chemical business, Cellanese had in mind the depression of 1929. During that period the company became concerned about future supplies of acetic acid, and established research work at Cumberland, Md., for production of the acid from petroleum hydrocarbons. Research at Cumberland led to the decision to build the plant at

Bishop. Construction started after war came in 1941, and the first unit went into operation in April 1945. During that year Chemcel started making acetic acid, acetaldehyde, acetone, formaldehyde and methanol. In 1946 Celanese decided to establish the Chemical Division to take over the growing chemical activities of the company.

Propane and butane, and to a certain extent dry natural gas, are the basic raw materials which the Bishop plant converts into organic chemicals required in such fields as synthetic resins, plastics, protective coatings, pharmaceuticals, dyes, synthetic textiles, solvents, and chemical intermediates.

Propane and butane, purchased from the La Gloria Corp. and The Chicago Corp., are brought into the plant as liquids via pipeline at around 200,000 gpd. and are stored in horizontal pressure tanks. Dry natural gas, bought from the La Gloria Corp., is pipelined into the plant at a pressure range of 400 to 600 psi. and is used in gas engines, as boiler fuel and as a source of hydrogen. The principal non-hydrocarbon raw materials are caustic soda and lime.

In the generation of hydrogen the dry natural gas is processed in a standard Girdler hydrogen unit, where the gas is reacted initially with steam over a nickel catalyst at temperatures of around 1,500 deg. F. to produce, as end products, hydrogen, carbon monoxide and carbon dioxide. Carbon monoxide is subsequently converted to carbon dioxide and additional hydrogen.

With reference to the general processing steps in the plant, the principal equipment consists of four primary partial oxidation units, two units for separation and purification of products from the primary oxidation step, two units for the production of formaldehyde, an acetic acid plant and a unit for the separation and purification of alcohols and specialties.

Prior to oxidation, gaseous propane and butane are compressed. Air is also compressed at this point. Twenty-two gas engine driven compressors, having a combined rating of about 25,000 hp., are used in the service. The oxidation equipment is so arranged that propane or butane or a mixture of the two can be processed at will. In the oxidation step, careful control of pressures, temperatures and concentrations is essential, as the character and yield of products are readily responsive to the operating variables.

With a few exceptions all the finished chemicals made in the plant originate at the point where oxidation takes place. In the two purification units are segregated all chemicals but formaldehyde and acetic acid. Formaldehyde has a separate refining unit; while acetic acid is manufactured by oxidation of acetaldehyde, one of the primary oxidation products.

In the Bishop plant most of the chemical engineering unit processes with the exception of those for processing solids are used. The wide variety of process equipment reflects the fact that numerous intermediate and finished chemicals are handled, among these being a number that form constant boiling mixtures or which have very close boiling points. The unit processes used include fractionation, azeotropic distillation, extractive distillation, liquid-liquid extraction, evaporation, absorption, hydrogenation, dehydrogenation, dehydration, hydrolysis, and vapor and liquid phase oxidation.

Outdoor installations prevail, and the plant resembles in general appearance the typical large petroleum refinery with its many towers and general use of aluminum paint. The minimum use of enclosed structures has the advantages of lower investment and lessened possibility of vapor accumulations.

Corrosion

Like most chemical plants, Chemcel has its corrosion problems although little or no corrosion is encountered in processing until the oxidation step, where organic acids make their appearance. The propane, butane and natural gas are substantially free of sulphur compounds and can be handled in carbon steel equipment. Much stainless steel is used in the handling and storage of chemicals.

Product lines carrying chemicals from the units to intermediate and final storage tanks are both above ground and underground. In some instances of underground construction, cathodic protection is used. The tendency at Bishop is now toward the laying of piping above ground because this procedure facilitates repair work and changes and makes it easier to detect leaks.

An effective system has been installed to circumvent corrosion of the 22-in. line which carries water from the Nueces river a distance of 25 mi. to the plant. After about a year of operation water demand exceeded the capacity of wells which were originally intended as the water supply. With well water both limited in volume and tending to scale in cooling service and require excessive treating for boiler use, supplementary surface water became advisable both from quality and quantity standpoints.

At the time the water line was required, cast iron pipe was unobtainable. Carbon steel pipe was employed, a fact which necessitated corrosion protection outside and inside the pipe, which is laid underground. For outside protection the pipe was doped and wrapped. Further, 17 magnesium anodes were buried along the line in order to furnish cathodic protection in addition to the wrapping.

For interior protection a deaeration system was installed last year. This consists of a vertical steel tower 12 ft. in diameter and 30 ft. high including the hemispherical heads. The tower is packed with 16 ft. of wooden slats, and is maintained at a vacuum of about 28 in. of mercury by electrically driven, two-stage, reciprocating vacuum pumps. River water is drawn into the top of the vessel and as it falls down over the packing the dissolved air is removed. The water then passes through electric centrifugal pumps and is carried to a silt pond at the plant before being used. About 95 percent of the oxygen is removed from the water by deaeration. The deaeration system and the water pumps operate automatically and require only occasional attention.

To check on corrosion and to inspect the build-up of deposits inside the line, three test spools, one at each end and one in the middle, have been installed in such a way that the spools may be removed for inspection without interrupting the line flow.

Water Treatment

An unusual economy in water treating is possible because of the combination use of well and river water and the differing character of the two waters. Since much of the steam used in processing is not available as condensate suitable for boiler feed, it must be replaced with treated water. The well supply contains a large excess of sodium bicarbonate and would have to be treated with sulphuric acid before softening with lime. On the other hand, the river water would require sodium carbonate treatment to remove permanent hardness as well as lime to remove temporary hardness.

It has been found that a proper mixture of well water and river water needs neither acid nor sodium carbonate treatment before the addition of lime. A considerable saving in chemical costs is therefore realized. The proper ratio of the two waters fed to the lime treater is determined

by titration only of the river water, as the well water composition is constant. The ratio, maintained by a flow controller, averages about two-thirds river water to one-third well water.

The plant uses, as a daily average, about 4 million gal. of makeup water, including that for boilers and miscellaneous requirements, and circulates 230 million gal. by means of gas engine driven centrifugal pumps.

An unusual source of power is used to drive the fans on two of the four induced draft cooling towers in the plant. A portion of the hot compressed exit gases from the oxidation units is expanded through gas turbines which operate these fans.

The plant uses very little electric power. That which is used is purchased, although a small gas engine driven generator is held in standby. Turbo-generators were difficult to obtain at the time the plant was built, and in addition the use of steam affords a large degree of flexibility. The low cost of natural gas was another factor in favor of steam. All process pumps are driven by steam turbines. Most process pumps have spares.

Shipments

Tank cars move most of the chemicals produced at Bishop. Some products are shipped in steel cars lined with plastic materials. Aluminum cars are also used when acetic acid is to be moved. Beam scales are used to determine the weight of empty cars entering the loading area and the same cars after filling. Methanol shipments, made on a volume basis, are not weighed.

Smaller shipments are handled in standard 55 gal. drums of steel or aluminum. The drum loading plant, completed in 1947, is a steel frame structure with corrugated aluminum roof and sides and concrete floor.

Chemical waste materials, most of which are contained in water from the processing units, are pumped to evaporation ponds occupying a total of 270 acres. Solar evaporation is aided by forcing the water through a group of riser pipes and into the atmosphere through spray nozzles on the risers. A second method of accelerating evaporation consists of atomizing part of the water through ejector sprays by means of a portion of the compressed nitrogen from the oxidation units in the plant.

At Clarkwood, a small locality five miles outside Corpus Christi, is the unusual, highly specialized Petroleum Research Center which does the research and development work for the Chemcel plant. Construction at Clarkwood began in July, 1946, and operations began early in 1947. Of the total personnel of approximately 100, graduate technologists number 31, of whom 10 are chemical engineers.

The principal functions of the Clarkwood plant, an investment well over $1,000,000, are: (1) to develop improvements in processing at Bishop, (2) to work out new applications for primary chemicals made at Bishop, (3) to develop ideas for additional chemicals which might be made at Bishop.

The laboratory research work covers analytical chemical research and control analyses; development of physical analytical methods and instruments; and organic synthesis studies concerning the conversion of Chemcel primary chemicals into more valuable finished products, as well as investigation of new raw materials. The engineering research group takes over developments worked out in the laboratory and carries these developments forward on a pilot plant scale.

The pilot plant operation group, over which a chemical engineer is superintendent, is a staff of young men who have had considerable experience in petroleum refineries. Once the process conditions have been laid out by the superintendent, these men keep the plants going. Operation is normally seven days a week.

The maintenance and utilities division has the job of furnishing steam and other utilities and also the responsibility for repairing, erecting and altering the pilot plants. Pilot plant maintenance is a considerable task in view of frequent changes in processing arrangements and instrumentation.

Construction

Relatively little of the experimental equipment at Clarkwood is housed. One exception is, of course, the laboratory, which is sheltered in a standard 40x120-ft. Quonset hut having a concrete floor. An impressive sight is the trim double line of aluminum painted towers of the pilot plants standing on a concrete slab 100 ft. wide by 180 ft. long. Six such plants were in operation in May and two more were under construction. The highest fractionator is 56 ft. in height and has a diameter of 22 in. The pilot plant equipment is designed to withstand hurricane winds up to 125 mph.

Great flexibility with respect to erecting new pilot plants or altering existing units is obtained by mounting the towers and other equipment along two sides of a steel frame serving as a supporting structure. This frame, in the plan view, is a rectangle formed by a line of I-beams 125 ft. long and 10 ft. wide. The beams are spaced at 25-ft. intervals, thereby forming five bays. Twelve ft. above the slab is a diamond tread steel floor supported on channels fastened to the I-beams. Twelve ft. above this is a second floor similarly constructed to the first.

The entire assembly is therefore an open steel lattice or trellis on which individual units of equipment may be quickly attached or dismantled. At the same time it carries the piping manifolds fitted with convenient outlets for water, butane refrigeration, steam, electricity, compressed air, fuel gas and vacuum. Running the length of the structure on each side is an open drain about two ft. wide by one ft. deep. Covered by steel grating, this drain receives waste discharges from the pilot plants and allows volatile products to be dissipated before reaching the sewer.

Two instrument control houses are situated within the supporting structure on the concrete slab. One of these governs the oxidation pilot plant and the other shelters instruments for the other units. Aside from the pilot plants the only additional facilities situated on the slab are the working tanks.

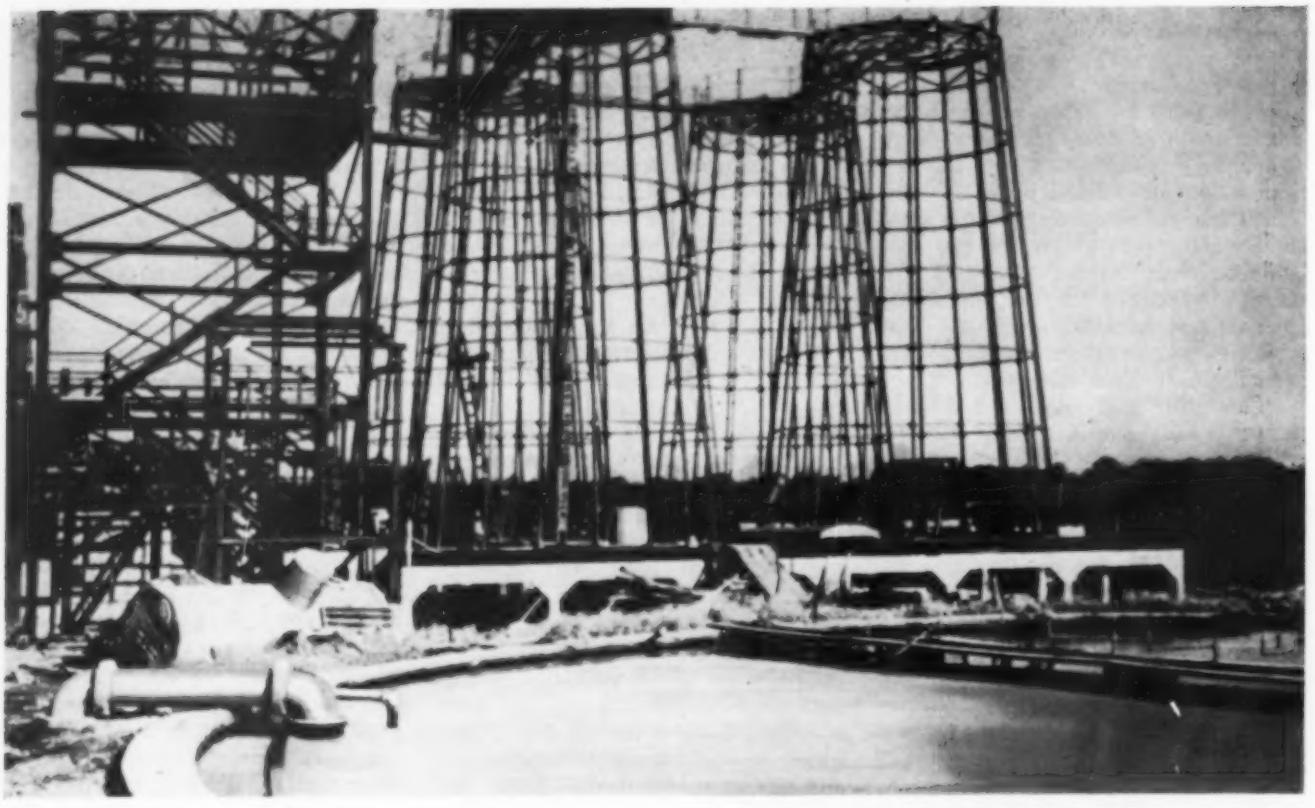
Future Growth

The Clarkwood installation was planned with a view to future growth. At present a plot of only five acres is enclosed, but 45 acres more are available when needed. The concrete slab is sufficiently long as it now stands to permit approximately a 75-ft. extension of the supporting structure and can be lengthened materially within the area now fenced.

In May a "pre-pilot plant" laboratory was being built. This laboratory is designed as a way-station between experimentation in glass and the present pilot plants. Equipment is steel. Housing for the equipment is a steel frame building with a corrugated aluminum roof, corrugated galvanized iron sides and concrete floor. Around the walls, close to the roof, is a screened strip to allow gases to dissipate and to aid in ventilation.

Raw materials for the work at Clarkwood are, as would be expected, consumed on a small scale. Trucks bring in liquefied propane and butane from the La Gloria Corp.; these materials are stored in horizontal pressure vessels. Natural gas is purchased from the Southern Minerals Corp. in the vicinity.

A typical water-cooled chamber plant built in 1944-45 . . .



Steel framework for four Mills-Packard acid chambers while under construction at Standard Chemical Co.'s plant, Troy, Ala.

A year later the finished chambers looked like this. Lead plates are held by the steel structure shown in the picture above.

Development Continues in Chamber Acid Plants

Although box chambers are seldom built today, some 57 water-cooled chambers of the improved Mills-Packard type have been erected in the United States since early 1942.

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HISTORY and development of the Mills-Packard water-cooled sulphuric acid chamber (of which the improved Mills-Packard chamber is the offspring) have been published in previous issues of *Chemical Engineering* and in other technical periodicals (e.g., *Chem. Met. Eng.*, **24**, p. 786-8, 1921; and *Trans. A. I. Ch. E.*, **33**, p. 563-77, 1937). Invented by two Englishman, W. G. Mills and C. T. Packard, as long ago as 1914, the Mills-Packard chamber was covered in the United States by U. S. Patents 1,112,546, 1,312,741 and 1,312,742.

Chamber Shape

The characteristic shape of the Mills-Packard chamber is that of a truncated cone, this shape being well adapted to effect another characteristic —the even and uniform spreading of a film of cooling water over the outside surfaces of the chamber curtains, when a stream of cool water is applied to the center of the chamber dome. The early Mills-Packard chambers were built in three sizes, comprising approximately 7,300, 12,000 and 19,000 cu. ft. in volume, with a height of from 40 to 47 ft. The curtains of these early chambers were supported by a series of five or six horizontal lead straps, some 15 in. wide and entirely encircling the chamber, suspended from rings of 2-in. iron pipe attached to nearly vertical T-bars, and burned at the lower edges to the chamber curtain, at different elevations, and spaced apart some 6 or 7 ft. Each of these lead straps formed a V-shaped trough about 12 in. deep with the side of the chamber, and of course obstructed the downward flow of the cooling water. It, therefore, became necessary to redistribute the cooling water at each trough, and this was done by perforating the trough, near its upper edge, with a series of ½-in. holes spaced 2 in. apart.

These early Mills-Packards produced sulphuric acid at a space rate of from 2.75 to 4 cu. ft. of chamber space per pound of sulphur burned per 24 hours, depending on the SO_2 content of the burner gas. These chambers enjoyed a considerable degree of popularity in England, France, Italy, Belgium and other countries for about a dozen years, but no Mills-Packards were erected in the United States until 1925 when the Armour Fertilizer Works built eight of the 12,000 cu. ft. size at Jacksonville, Fla. In the following year a method of upright strapping of the chamber curtains was invented, using 2½-in. wide lead fins reinforced on either side with steel bars. These were bolted to steel links attached to eye-bolts secured in turn to the sloping T-bars which constituted the main supporting members of the chamber (U. S. Patent 1,627,043). This upright method of strapping the chamber curtains soon supplanted the horizontal method and the redistributing troughs on the later Mills-Packards were absent. The cooling water could thus flow down the chamber sides from top to bottom without interruption.

These later Mills-Packards—like the earlier ones—had the luted type of pan, with the lower edge of the curtains dipping into the body of acid contained in the chamber pan and forming a liquid seal for preventing the escape of gas or the entrance of air. With this arrangement it was necessary for the collecting trough for the heated cooling water to be attached to the chamber curtain above the top of the pan upstand. The chamber pan was a separate structure, with bottom and upstanding sides about 2½ ft. high, and was independent of the chamber curtains except in so far as it cooperated with the lower ends of the latter and with its acid contents to form the liquid seal. The pan walls were surrounded by boards on end, flat sides against the lead upstand, and encircled by steel hoops or wire rope. The pan upstands and the lower ends of the curtains were not water-cooled, and thus the cooling effect was less than the maximum possible.

In the United States the Armour Fertilizer Works, encouraged by its trial of Mills-Packards at Jacksonville, built additional chambers of this type at Navassa, N. C., and at Houston, Tex., and in 1928 the American Zinc Co. of Illinois erected six Mills-Packards as an extension to its box-chamber plant at East St. Louis, Ill.

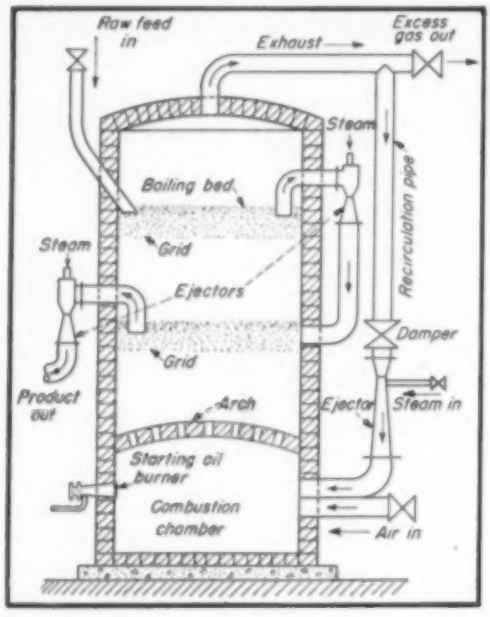
Overcoming Failings

It was for the purpose of overcoming the deficiencies of the Mills-Packard chamber that the improved Mills-Packard chamber [U. S. Patent 2,345,661 (1944)] was devised by the writer. The principal features of this development are as follows:

1. The luted type of chamber pan is replaced by a pan of the burned type, the curtains being rolled thicker for a length of about 2 ft. at the lower end in order to serve as pan upstands, and rolled long enough to provide 2 or 3 in. of length to be turned inwardly and flat on the chamber bottom and burned to the latter.

2. The wooden supports for the pan upstand are abolished and the pan up-

(*Continued on page 111*)



Fluidization Used in Making Activated Carbon

New kiln for producing activated carbon is used in process developed by CIPA of Switzerland.

A. Godel*
President and General Manager
Société Anonyme Activit, Paris, France

ACTIVATED carbon production has taken on much importance in recent years owing to its many applications in the fields of adsorption and bleaching. In general, its production methods fall into two groups, chemical and physical. Probably the latest development among the physical methods is a process based on fluidization which is now being employed successfully in the French establishment with which the author is connected.

In the so-called chemical processes, raw cellulosic materials, such as sawdust, peat, brown coal and the like are treated without preliminary carbonization with zinc chloride or other activating agent, after which the material is calcined in an inclosed chamber at a moderate temperature, and the residual material is washed to eliminate the salts. The resulting product is activated carbon.

In the so-called physical processes a carbonaceous material, either raw or after a preliminary carbonization, is brought to red heat and submitted to the semi-oxidizing action of activating gases such as steam or carbon dioxide. A water-gas reaction results which should not be continued beyond a limit depending on the technique applied and the result to be obtained. Ordinarily this process is carried out in rotary kilns or in vertical kilns provided with continuous flow over baffle plates. Special arrangements are necessary for the introduction of heat since the activation reaction is endothermic.

The physical processes, involving the use of activating gases, require extremely intimate contact between carbonaceous material and gas at high temperatures, leading to problems in control of the water gas reaction and in securing extreme uniformity of treatment, not only from particle to particle, but throughout each particle.

Newer Process

The fluidization process described here overcomes the disadvantages commonly encountered and permits extreme uniformity of results to be accomplished. As is well known, of course, fluidization has heretofore been applied largely in the catalytic cracking of hydrocarbons. In this application, the catalyst particle becomes heavier as it accumulates carbon, whereas quite the reverse is true in a process applying fluidization to the activation of carbonaceous materials. In the latter case a loss in weight as high as 85 percent may take place with sawdust as the starting material, and it is apparent that this considerable change in physical characteristics requires the application of a type of process differing materially from the fluid catalyst process.

The process described here was developed by the Compagnie Industrielle de Procédés et d'Applications, Fribourg, Switzerland. The first industrial scale application has been made at the plant, of the Société Anonyme Activit, at Vernon, France. The initial installation involved a kiln of about 3,600 lb. per day production capacity which has been operating for about a year, while a second kiln, of similar characteristics but of larger capacity, is now being built at the same plant to incorporate certain improvements in automatic operation and in heating.

Development of the process involved extensive investigation, and the solution of many problems, and has resulted in a number of patent applications in various countries including Swiss Patent Application 14,559, French Provisional Patent Applications Nos. 533,884 and 537,938, and U. S. Patent Application, Serial No. 767,209.

The process as finally worked out consists in the treatment of finely granulated raw carbonaceous materials, either untreated or preliminarily carbonized, in a fluid bed produced by upwardly flowing activating gases brought in at a red heat. The solid material forms layers about 10 in. or more in thickness over a horizontal perforated grid. The activating gases consist of a mixture of air, combustion gases and steam at 900 deg. C., flowing at sufficient velocity to produce turbulence in the carbon without lifting solid particles beyond the surface of the pseudo-liquid layer.

Under these conditions the turbulent layer assumes the appearance of a liquid and its liquid-like properties include ready flow over horizontal surfaces and production of a remarkable degree of mixing and heat transfer. These characteristics of the fluidized bed make it possible to handle solid products in various manners similar to liquids and to secure in this

* Mr. Godel, whose company is the initial licensee under the patents of the CIPA process, is also president of the French Chamber of Industry and Commerce for Activated Carbon, Decolorizing Earths and Filter Aids.

fashion a high degree of uniformity of reaction.

As compared with the use of other types of kiln for activation, the new process gives a higher yield on the weight of raw material employed, since, by giving more uniform treatment, it reduces superficial oxidation of the particles to a minimum and at the same time permits the treatment of products formed from very finely granulated material.

The accompanying illustration shows a cross-sectional view of a kiln of the type now being employed by Société Anonyme Activit. The kiln is a vertical cylinder containing a combustion chamber in its lower portion, separated by a perforated arch from the section above which is provided with two horizontal, perforated plates for the formation of the two-stage fluidizing section. The granulated feed material, in sizes from 0.08 in. to 2 in., is introduced continuously into the upper bed and, after a period of treatment, is withdrawn by a steam ejector to the lower fluidized bed. Here again, after a period of treatment, the finished material is withdrawn and conveyed to storage by the ejector at the left.

Heat for the process is provided initially by a starting oil burner which is shut down after the process is operating stably. Exhaust gas leaves from the top of the kiln and part of it is recirculated to the combustion chamber by the action of a steam ejector. By reason of the water gas reaction, the gas produced is high enough in calorific value to conduct the reaction without outside heat. Additional air is introduced into the combustion chamber along with the recycled gas and the steam supplied to the ejector. There is an excess of combustible gas which is drawn off at the top of the apparatus for other desired heating applications around the plant. Necessary valves are provided at several points for balancing the flow to produce the desired temperature and density conditions in the boiling bed.

Experience in the use of the fluidization method for producing activated carbon has shown that not only is the method of higher efficiency in giving a greater yield with closer control of product quality, but it also permits the use of pulverized or finely granulated raw materials which do not require preliminary carbonization. Such raw materials are practically useless with other activation methods relying on physical means. Since materials of this character generally are industrial wastes, they tend to be plentiful and economical in use.

In conclusion the author wishes to express his appreciation to the Compagnie Industrielle de Procédés et d'Applications for permission to publish here details of the novel techniques involved in this process.

Editor's Note—It is an interesting fact that a process which made use of fluidization in the production of activated carbon was employed during the war in the Mobile, Ala., plant of the Pan American Shell Co., to process nut shells.

CHAMBER ACID PLANTS

(*Continued from page 109*)

stand is stiffened against outward thrust of acid contents by upstanding ribs of hard lead spaced about 2½ ft. apart and encircled by a series of adjustable steel or wrought iron bands.

3. The trough for collecting the heated cooling water is lowered from the former position above the top of the pan upstand to a position on the chamber platform, and its inner wall is the upstand of the chamber pan itself, while its outer wall is supported by the upstanding web of the base angle ring—the member on which the T-bars, mainstay of the chamber framing, rest.

Chief advantages of this development are that, by combining the pan and curtains of the chamber into an integral chamber unit, the pan upstand and the lower ends of the curtains are united and the lead formerly dipping into the pan is saved, thus reducing construction cost. Also, the area of chamber surface that is water-cooled is increased by from 5 to 7½ percent, depending on the size of the chamber. Water-cooling is thus extended to the corner of the chamber pan where the lead turns from the vertical to the horizontal, which is the most vulnerable part of a chamber for corrosion by acid. Finally, the acid contained in the pan at this corner is also water-cooled, and the frequent renewal of the chamber skirting dipping into the acid contained in the luted type of pan is avoided. All the good features of the later type of Mills-Packard chamber are retained, and to them the benefits of water-cooling the chamber pan as noted above have been added. The rated capacity of the improved Mills Packard chamber is from 2.6 cu. ft. of chamber space per pound per day of sulphur, with brimstone gas, to 3.5 cu. ft. with sulphide-ore gas; but in practice these rates have been lowered by a considerable margin.

During 1942 and since that year the total number of improved Mills-Packard chambers built in the United States has been 57, with a combined acid-making capacity of 805 tons of 60 deg. Be. acid daily, distributed among 12 different plants, located in eight different states. Of these 57 chambers, 34 were distributed among five entirely new chamber plants; 18 were at four plants in process of conversion from box chamber plants to improved Mills-Packard plants; and five were built as extensions to the production capacity of box-chamber plants.

Including the parent Mills-Packard as well as the improved modern Mills-Packard chambers, the total number of conical water-cooled chambers erected in the United States since 1924, is 136, distributed as follows: Alabama, 4; Florida, 36; Georgia, 13; Illinois, 12; Michigan, 4; Mississippi, 2; North Carolina, 9; Ohio, 10; Pennsylvania, 30; South Carolina, 10; and Texas, 6. The combined production capacity of these chambers is 1,868 tons of 60 deg. Be. acid per day.

Characteristics of the improved Mills-Packard plant which are cited among its users include reliability, since the plant can be counted on to produce its acid quota every day, with shut-downs for repairs, when needed, only of short duration. The plant requires only about half the weight of lead needed by a box chamber plant, per ton of capacity, which means a substantial reduction both in construction and in lead-maintenance costs. The fact that no building is needed means a further reduction in construction and maintenance costs, while the compactness of the plant (about one-third the area of an equivalent box chamber plant) means lower fixed charges and minimum supervision.

Chamber space per pound of sulphur burned per day is reduced from 6 to 8 cu. ft. for box chambers to 2.6 cu. ft., and the individual chambers, being small in diameter, are easily and cheaply bypassed. Quick renewal of the chamber bottoms is possible when that is necessary. Finally, the plant has no catalyst to be screened, no boiler tubes to be cleaned, raises no steam and thus needs no licensed engineer.

Recently (Feb. 1948, p. 105) *Chemical Engineering* remarked editorially that "It is still premature to discuss the demise of the chamber plant." Since the life of a chamber plant is anywhere from 25 to 40 years, depending on the intensity of operation and the efficiency of management and maintenance, it seems likely that such a discussion will remain premature, to say the least, for a long time to come.

Using statistical analysis, engineers can determine

Blender Efficiency

J. P. Beaudry
Shawinigan Falls, Quebec

Complicated mathematical derivation leads to simple formulas that show how well your blender is operating.

APPLICATION of statistical methods in the field of chemistry and engineering, although quite recent, has been singularly rapid. The quality control chart is fast becoming a familiar sight in a large number of plants, and statistical methods of investigation, such as correlation analysis and factorial experimentation, are rapidly becoming popular. These well-known techniques do not exhaust the field of application of statistical methods, however, as the following application to blending indicates.

A mass of literature has been written on agitation within the last decade. Much of it has proved useful, but the lack of general criteria for measuring the intensity of agitation has markedly retarded the development of a general theory of agitation. Statistical methods, however, do offer a quantitative measure of agitation amenable to mathematical treatment.

The analysis below applies strictly to blending, but the application of the method to the study of agitation is readily apparent.

First consider blending as that operation by which various batches of a solution or mixture are mixed so as to increase the uniformity of the product. In batch production it is impossible to prepare identical batches; the properties of the product oscillate about their mean values. The variability of a particular property (property A) of the product can be expressed mathematically as

$$V_b = \frac{\Sigma(c_i - c_{av})^2}{N} = \frac{\Sigma c_i^2}{N} - c_{av}^2 \qquad (1)$$

where V_b is the variance of property A between batches (variance within batches being assumed nil), c_{av} is the average value of property A, c_i is the value of property A for the ith batch, and N is the number of batches sampled. The summation extends from 1 to N. Formula (1) can be taken as rigorous when N is greater than 30.

Now, if these batches are blended, samples taken at the outlet of the blender at a particular instant in each cycle will be more uniform. For M such samples, Formula (1) gives

$$V_s = \frac{\Sigma x_j^2}{M} - x_{av}^2$$

where V_s is the variance of samples taken at the outlet of the blender, x_j is the value of property A for the jth sample, and x_{av} is the average value of property A for the samples.

It can be seen that the ratio V_b/V_s will be a measure of the amount of blending received. Where no blending takes place, V_s will be the same as V_b and the ratio will be unity. If the blending were theoretically perfect, V_s would be zero and the ratio would be infinite. The ratio V_b/V_s is called the "blending ratio."

Ratio and Design

To relate the blending ratio with the design of a blender, assume: (1) Individual batches are homogeneous; that is, in statistical terminology the within-batch variability is nil; (2) errors of analysis are nil; and (3) the characteristic of the solution or mixture to be studied is additive. For instance, if batches of equal volume are blended, the characteristics of the mixture will be the arithmetic mean of the characteristics of the individual batches. This latter condition holds for the percentage composition of most solutions. Assume that the characteristic being studied is the concentration of component A in the solution or mixture to be blended.

The upper limit of the blending ratio can be established by considering the performance of an ideal blender; that is, one within which a solution is homogeneous at any instant. The type of cycle followed by the blender must also be specified. Three possible types are: (1) Where one batch goes in at a time, inflow and outflow are simultaneous, and the level in the blender is held constant; (2) where one batch goes in at a time, inflow and outflow are not simultaneous, outflow beginning at the end of inflow of a batch; and (3) where one batch goes in at a time, inflow is intermittent, and outflow is continuous.

The following analysis covers the first of the three types, Case (1), where, it will be noted, the rates of inflow and outflow are equal. Let D equal the ratio of blender volume to batch volume. For purposes of analysis, if the volume of a batch is taken as the unit volume, then D becomes simply the volume of the blender. Also let x_0 be the concentration of A in the blender at the beginning of inflow of Batch 1; c_1 be the concentration of A in the batch entering the blender (Batch 1); x be the concentration of A in the blender at any time; x_1 be the concentration of A in the blender at the end of the inflow of the first batch; dv be an element of volume; and dx be an increment of change of x. Then, as $c_1 dv$ enters the blender, and $x dv$ leaves it,

$$dx = (c_1 dv - x dv)/D \qquad (3)$$

Integration of (3) between the given limits results in

$$\int_{x_0}^{x_1} \frac{dx}{c_1 - x} = \int_0^1 \frac{1}{D}\, dv$$

or $\ln (c_1 - x_0)/(c_1 - x_1) = 1/D$. By letting $1/D = \ln 1/K$, or saying $K = e^{-1/D}$, this equation reduces to

$x_1 = (1 - K)c_1 + Kx_0$. The general form of the equation then becomes*

$$x_n = (1 - K)\,c_n + Kx_{n-1} \qquad (4)$$

We may now derive a relationship between the variance of the concentrations of A between batches (V_b) and the variance of the concentrations of A in samples taken at the outlet of the blender at the end of inflow of individual batches (V_p, where the subscript p stands for x_n; in like manner let the subscript q stand for x_{n-1}).

This relationship† may be found from the following theorem: If Z is a function of X and Y, which are independent variables, and we are given the variances of X and Y as V_x and V_y, then

$$V_z = V_x\left(\frac{\partial z}{\partial x}\right)^2 + V_y\left(\frac{\partial z}{\partial y}\right)^2$$

For the case under study, therefore, application of the theorem gives

$$V_p = V_b(1 - K)^2 + V_q(K)^2$$

But when n is large, V_p and V_q are almost equal and we can assume that they are equal. Then we can reduce the above equation to

$$V_b/V_p = (1 + K)/(1 - K) \qquad (5)$$

Since K is a function of D and S, both known values, the value of the ratio V_b/V_p can readily be calculated.

Blender Efficiency

The ratio V_b/V_p represents a limiting value which an actual blender can approach but never surpass. As such, we may call it the "limiting blending ratio" and give it a convenient symbol γ. For the three types of blending defined above, we can then substitute the three different values of K into Equation (5).

$$\gamma_1 = \frac{1 + e^{-1/D}}{1 - e^{-1/D}}$$

$$\gamma_2 = 2D - 1$$

$$\gamma_3 = \frac{1 + \left[\dfrac{SD}{SD - (S - 1)}\right]^{-S/(S-1)}}{1 - \left[\dfrac{SD}{SD - (S - 1)}\right]^{-S/(S-1)}}$$

It is an interesting point that for all values of D, γ_1 is the largest, γ_3 is the next, and γ_2 is the smallest. Thus Method (1) is the best. This applies only to a perfect blender, of course.

In practice, sampling before and after blending will give a blending ratio lower than γ, since perfect blending is not attained. If we recall that the blending ratio is unity when no blending takes place, we see that we can erect a scale with a lower limit of 1 and an upper limit of γ. The actual ratio V_b/V_p will fall between these two limits. A more convenient scale is obtained by subtracting one from each element in the scale, the new scale running from zero to $(\gamma - 1)$. The blending ratio found in actual practice must also have 1 subtracted from it. Using this scale, the blending efficiency (B. E.) expressed as a percentage of the efficiency of a perfect blender is given by

$$\text{B. E.} = [(V_b/V_p)_{act} - 1](100)/(\gamma - 1) \qquad (6)$$

It can be seen that the blending efficiency, as defined by (6) is a mathematical measure of the degree to which a blender approaches the perfect blender. It is independent of D, and of the type of cycle, and depends solely on the internal design of the blender and on the properties of the mixture being blended. The limiting blending ratio γ is independent of the internal design and depends, so to speak, on the external design of the blender. The actual blending ratio will be a function of γ and of the blending efficiency.

Although the above theory is somewhat involved, applications of it are quite simple. The following case is worked out as an example.

In a viscose plant, batches of viscose were blended in a blender whose capacity was three times the volume of the individual batches. Thus $D = 3$. A Type (1) cycle was followed. Calculating from Equation (5) for this type cycle, $\gamma = 6.1$. Here, 30 batches were analyzed for caustic, as well as 30 samples of blended viscose taken at the end of inflow of the corresponding batches. For the batches going in the average caustic concentration was 6.5 percent, and it was also 6.5 percent in the samples of blended viscose. However, using Equation (1), the variation in the batches (V_b) was 0.0026. Similarly, using Equation (2), the variation in the blended viscose samples (V_p) was 0.0010. Hence the blending ratio is given by $0.0026/0.0010 = 2.6$. Therefore, from Equation (6), the blender efficiency was $(2.6 - 1)(100)/(6.1 - 1) = 31.4$ percent.

Since this low figure indicated poor efficiency, stirring and recirculation in the blender were improved. The tests were then repeated giving the following figures: $V_b = 0.0028$, $V_p = 0.0006$, the actual blending ratio $= 4.66$, and the blending efficiency $= 71.8$ percent.

The concepts of blending ratio and blender efficiency described above have been found quite valuable in the improvement of existing equipment. Since the basic laws of agitation apply to any type of agitation as well as to blending, correlation of blender efficiency with such factors as stirrer speed, volume, shape of blender, viscosity, and power consumption, should prove fruitful to the whole field of agitation. These concepts should also prove useful in plant design involving installation of blending equipment, since they relate a process requirement, variability of product, with equipment design.

* It is interesting to note that blending types (2) and (3) may also be reduced to the same general equation. Proofs are omitted here but will be supplied by the author if requested. The three types of blending all result in Equation (4) when K is defined as follows for the three types:

(1) $K = e^{-1/D}$

(2) $K = (D - 1)/D$

(3) $K = \left[\dfrac{SD}{SD - (S - 1)}\right]^{-S/(S-1)}$

In type (3) S is defined as the ratio of inflow rate to outflow rate, the two being unequal unless there is no interruption between inflows.

† See O. L. Davies, Statistical Methods in Research and Production, Oliver and Boyd, London, 1947.

From Acetylene to Cyclooctatetraene

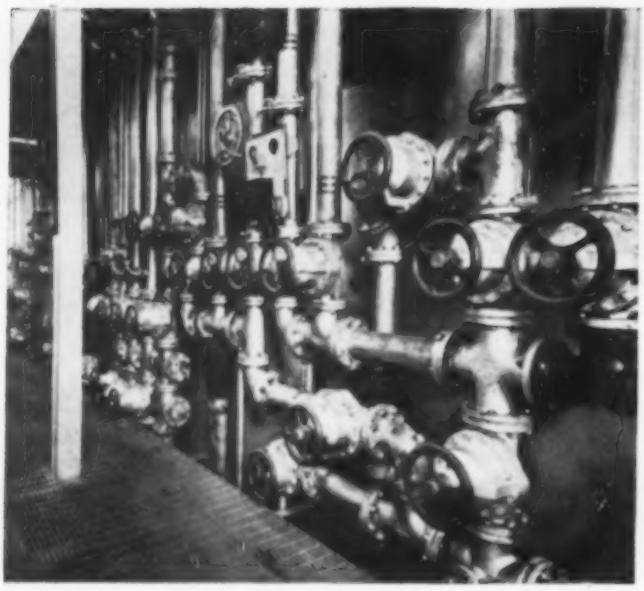
RESEARCH on polymerization of acetylene to produce cyclooctatetraene (COT) and homologs is one of the important developments in chemistry uncovered by American investigators in Germany.

In the process, worked out by I. G. Farbenindustrie's director of organic research, J. Walter Reppe, a nickel cyanide catalyst is suspended in tetrahydrofurane. This is brought into contact with acetylene in a nitrogen atmosphere at 15-20 atmospheres total pressure and temperatures ranging from 70-150 deg. C. After 50-60 hr. of reaction time the experiment is stopped as the rate of acetylene take-up becomes extremely slow. The reaction product is obtained in a brownish black solution with suspended cuprene. Cuprene and catalyst are filtered off.

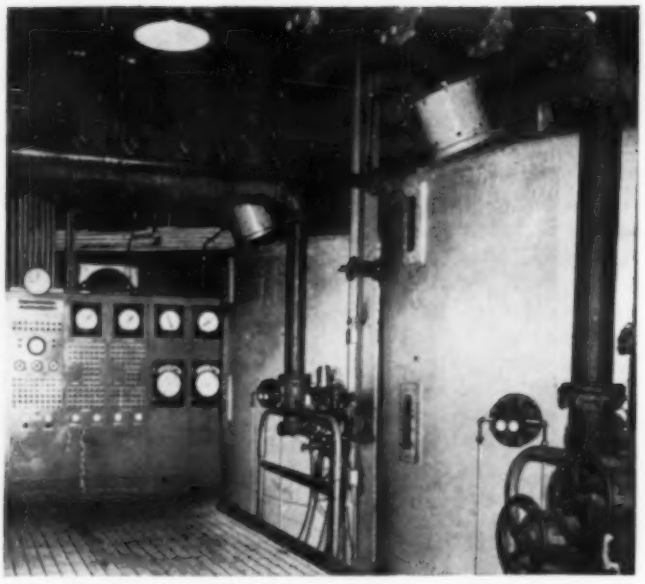
Between 1940 and 1944 polymerization of acetylene to COT was carried out experimentally at the I. G. Farben Ludwigshafen plant. Further development was discontinued in 1944 leaving the process still in the research stage. Yields are only fair to good and reproductibility of results is poor. Estimated over-all yield of COT and homologs, plus cuprene and benzene, is about 90 percent of that of the COT and the formation of benzene and resin 10-15 percent each of the COT.

An account of the process as worked out by Reppe is contained in a report "Polymerization of Acetylene to Cyclooctatetraene,"* published by the Office of Technical Services.

* PB-62593 "Polymerization of Acetylene to Cyclooctatetraene," mimeographed, $3.50, 139 pages. Order from OTS, Department of Commerce, Washington 25, D. C.



MANUAL CONTROL OF DEIONIZATION is thing of the present. It requires longer cycle, less initial outlay.



AUTOMATIC CONTROL OF DEIONIZATION is planned for most new units. Labor cost is lower, cycle shorter.

Ion Exchange in Beet

Last year three commercial ion exchange units were operating in the beet sugar industry. Here's what ion exchange now does and, more important, what it may mean.

B. N. Dickinson
Chemical Process Co., Redwood City, Calif.

What It May Mean to Process Industries

If the beet sugar industry converts 50 percent to the use of ion-exchange within the next decade and associated trends continue, what would be the major effects on the sugar and chemical process industries?

1. More Sugar, Less Molasses

(a) If adoption were non-selective, sugar refineries could recover from the same tonnage of beets about 55,000 tons more sugar now worth $8,250,000. About 90,000 tons less molasses would be made. But the reduced quantity of residual molasses could be upgraded to edible or confectionery sirup.

(b) If non-Steffens plants convert first selectively, then the 200,000 tons of straight house molasses not now Steffenized would be just about ion exchanged out of existence to yield some 90,000 tons more sugar in the bag. Loss of the nitrogen-rich molasses would be felt by the yeast industry which has long used it as a cheap and ideal culture medium.

2. Less Use of Sulphur, Limestone, Coke

Use of over 1,000 tons of sulphur annually would be eliminated in sugar refining; some 270,000 tons of limestone and 27,000 tons of coke would possibly be eliminated.

3. More Byproducts

Up to about 58,000 tons of 3-5 percent ammonium sulphate-chloride solution (as 100 percent sulphate) would be produced and probably used as a liquid fertilizer in adjacent beet fields. Sugar plants might become active in recovering pectin and byproducts such as glutamic acid, glutamine and pyrrolidone carboxylic acid for conversion to monosodium glutamate.

4. New Markets for Some Chemicals

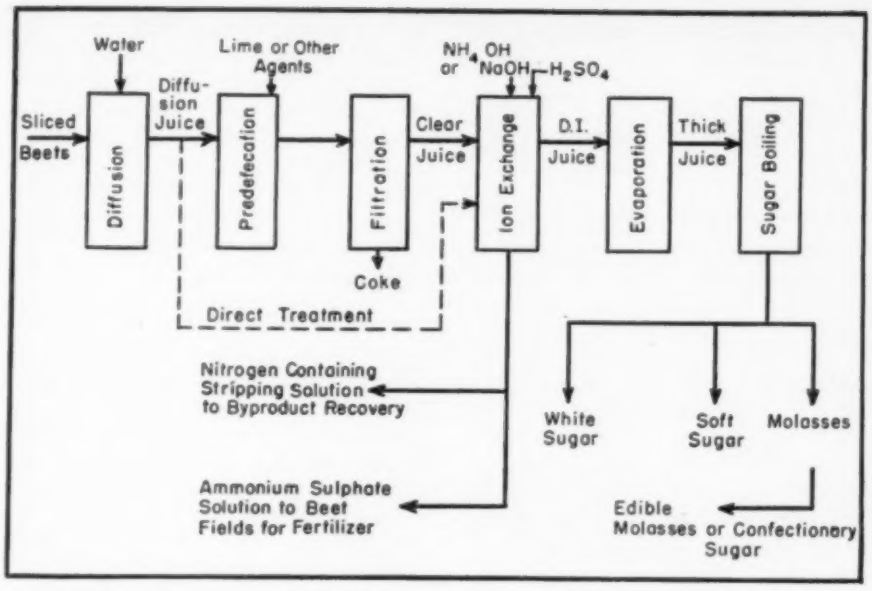
A new, seasonal annual market would be created for about 50,000 tons of 93 percent sulphuric acid and 15,000 tons of anhydrous ammonia or 30,000 tons of 100 percent caustic soda.

5. Less Market for Others

Make-up demand for resins would be small; new secondary market for phenol and formaldehyde would total only about 500,000 lb. annually.

6. Effect Would be Localized

Since about 75 percent of the beet sugar output comes from the western states, repercussion would be largely in the chemical and process industries of that area.



FLOWSHEET OF THE FUTURE may look like this. Ion exchange and other trends may revolutionize the process and equipment used in beet sugar refining.

Sugar Refining

ION EXCHANGE is making history in the beet sugar refining industry; there is increasing evidence that it will make more. Some engineers regard this development, used commercially for the first time last season, as potentially one of the most significant single advances during the industry's 70 years of existence in this country. If adopted on a wide scale, it will profoundly affect the technology (and the economics) of beet sugar refining.

Vallez Had an Idea

Henry Vallez of the Isabella Sugar Co., Mt. Pleasant, Mich., is usually credited with pioneering the use of ion exchange in beet sugar refining. After years of experimental and small pilot plant work, Isabella operated a semi-commercial unit in 1941. During the same campaign Union Sugar Co. operated a pilot plant at Betteravia, Calif. Amalgamated Sugar Co. operated a similar unit at Burley, Idaho. In 1945 Holly Sugar Corp. ran a pilot plant at Alvarado, Calif.

Vallez' idea has gone a long way since 1941. Last year three commercial ion exchange units were operated by the beet sugar industry. These were Holly Sugar Corp. at Hardin, Mont., Layton Sugar Co. at Layton, Utah, and Utah-Idaho Sugar Co. at West Jordan, Utah. The Twin Falls, Idaho, plant of Amalgamated Sugar Co. ran for a limited period on raw juice during 1946; it will operate on a large scale next season. A number of pilot plant and semi-commercial units are in existence. The principles of ion exchange can, of course, be used in a number of other industries. Table I lists the bulk of present installations in the sugar and sirups fields in the U. S. The important point to remember is that ion exchange is a relatively new unit operation in these industries that *may* result in major technological and economic changes (see *Chem. Eng.*, July 1947, pp. 123-130).

How fast and how soon? That's the crux of the matter for the chemical industry. Frankly, it is unlikely that the beet sugar industry will soon convert completely to the use of ion exchange purification. Factories without Steffens houses would be the logical ones to convert first. The economic picture may be more favorable in areas of low purity beets. It is reasonable to estimate on the basis of present preliminary data that 50 percent of the beet sugar capacity of the country may be converted within the next decade or sooner. If so, what would be the major effects on the sugar refining and chemical industries? The accompanying box summarizes the arithmetic of such a conversion. Since about 75 percent of the nation's beet sugar production comes from the West, this area would naturally receive most of the repercussions.

From West Jordan

Available data on results of the three commercial ion exchange units in the beet sugar field that operated last year are given in the following paragraphs.

Equipment at the West Jordan plant of Utah-Idaho Sugar Co. consists of three identical pairs of exchanger tanks. Each is 4 ft. in diameter and 12 ft. high and contains 75 cu. ft. of exchanger with a bed-depth of 6 ft. Other items include a sirup dilution tank at the remelt station, heat exchanger, raw sirup storage tank, sweet water storage, and three tanks for mixing regenerating agents. Pipes and valves are 2 in. in size. All equipment and lines are rubber-lined. Riffle boxes are provided to catch any exchanger backwashed from the tanks. The unit is operated manually. Differential air pressure maintains flow through the tanks—17 psi. maintained in the first tank, 15 in the second, 10 in the third, and not more than 5 psi. in the last.

This plant introduced an innovation by operating on a portion (about 25 percent) of the intermediate sirup produced from the high raw centrifugals rather than on second carbonation juice. Effluent sirup from the exchangers was returned to the thin juice fed to the evaporator. Sirup from the second centrifugals was diluted to 30 brix with sweet water from the exchangers and factory thin juice; the latter furnished the bulk of diluent. Temperature of the diluted sirup was then dropped from 60 to 20 deg. C. It was pumped into the exchanger battery to make a double pass through two pairs of deionization units in series. This was done so that the effluent flowed from a partially exhausted into a fresh pair.

The finished product was controlled by keeping the apparent sugar purity of deionization (D.I.) sirup composited hourly above 90 percent; this is about the average purity of the white pan at West Jordan. In addition, a color endpoint was taken when the exchanger effluent sirup, after dilution to the same brix as the thin juice, matched that of the thin juice.

Slight manipulation of air pressure kept a flow of 15 gpm. through the D.I. plant. This gave a cycle of 2.75 hr. for each pair in the clean-up position and the same for those in the fresh position—a total of 5.5 hr. in service. This may drop to 4 hr. when

Table I—Some Ion Exchange Installations in the Sugar and Sirups Fields in the U. S.

Firm	Plant Location	Type of Processing	Status
Amalgamated Sugar Co.	Burley, Idaho	Beet juice and molasses	Pilot plant and semi-commercial
Amalgamated Sugar Co.	Twin Falls, Idaho	Beet juice	Resuming operation next campaign
Corn Products Refining Co.	Argo, Ill.	Dextrose	Pilot plant
Corn Products Refining Co.	Corpus Christi, Tex.	Dextrose from milo maize	Commercial plant under construction
Corn Products Refining Co.	Pekin, Ill.	Corn Sirup	Commercial plant under construction
Hawaiian Pineapple Co., Ltd.	Honolulu, Hawaii	Pineapple mill juice	Commercial operation
Holly Sugar Corp.	Alvarado, Calif.	Beet juice	Pilot plant shut down
Holly Sugar Corp.	Hardin, Mont.	Beet juice	Commercial operation
Isabella Sugar Co.	Mt. Pleasant, Mich.	Various types of molasses	Pilot plant and semi-commercial
Juice Industries, Inc.	Dunedin, Fla.	Citrus wastes	Commercial operation
Layton Sugar Co.	Layton, Utah	Beet juice	Commercial operation
Pacific Chemical & Fertiliser Co. with Hawaiian Sugar Planters' Association	Oahu Sugar Co., Hawaii	Cane juice	Pilot plant shut down
Publicker Industries, Inc.	Philadelphia, Pa.	Maltose	Commercial operation
Union Sugar Co.	Betteravia, Calif.	Beet juice	Pilot plant dismantled
United States Sugar Corp.	Clewiston, Fla.	Cane juice	Pilot plant
Utah-Idaho Sugar Co.	West Jordan, Utah	Beet machine syrup	Commercial operation
Waverly Sugar Co.	Waverly, Iowa	Malfose	Commercial plant shut down

spoiled and low-purity beets are being used.

Cation exchanger was regenerated with about 4.2 lb. of H_2SO_4 (as 8 percent solution) per cu. ft. of bed in two stages. Last half of the regenerant was returned to the acid mixing tank and fortified to 8 percent with fresh acid. It was then used to regenerate another cation bed. Calcium sulphate accumulated in the acid mixing tank, but no build-up in the bed was reported. Anion exchanger was regenerated with 3 lb. of NaOH (as 8 percent) per cu. ft. of bed. The cation bed was rinsed weekly with caustic to remove protein and other accumulated organic compounds. The plant was in constant operation for 75 days during the campaign with no apparent loss of bed capacity except for a small abrupt drop during the first week.

With incoming raw sirup averaging 23 deg. C., the invert created by the double-pass system averaged 1.12 percent on dry substance. Invert in the final molasses was 0.5 percent on dry substance. By using low-purity machine sirup, it was possible to use the double pass without excessive inversion losses; enough impurities were apparently carried through the first pair to buffer against inversion in the second pair of exchangers. Passage of a relatively pure sugar solution through well-regenerated cation gives high inversion since evidently the cation exchanger in the hydrogen state acts as a solid catalyst in the absence of buffering impurities.

Engineering work at West Jordan was done by Utah-Idaho Sugar Co. The exchangers were manufactured by Chemical Process Co.

Table I summarizes results at this plant for the 1947 campaign, while Table II gives preliminary cost data per 100 tons of beets. Net profit shown in this table does not include amortization of initial exchangers, maintenance, resin losses, power or fuel. Required power is only that for operating five pumps. Since thin juice was largely used to dilute the intermediate sirup, little extra water was used; cost of extra fuel would thus be small. The high price prevailing for molasses at present is an abnormally high charge against ion exchange.

From Layton

The Layton plant of Layton Sugar Co. has four D.I. units in parallel. Each pair has 675 cu. ft. of cation and 412 cu. ft. of anion exchangers. The former occupied about an 8-ft. deep bed in a 10 x 14 ft. tank; the latter about 5½ ft. in a 10 x 11 ft. tank. Equipment is rubber-lined. All operations are manually controlled.

Layton began with a four-boiling system, but too much high-purity sirup went into discard molasses. Then a five-boiling system was installed. The boiling of ion-exchange sirup on the high-purity side was not greatly different from working standard beet juice. But low-purity liquors need better pan circulation since impurities removed by ion exchange are those which give heavy viscosities. Otherwise the crystals grow to a certain gravity and then settle out like sand, making it impossible to boil a low pan and hold it after 4.5 to 5 hr. A few low raw pans were dug out at Layton before this fact was realized.

A sugar extraction of 93.5 percent was indicated on the basis of a five-boiling system. A figure nearer 92 percent was actually reached during the 1947 campaign; this included some two weeks' run on straight house and a period when "bugs" were being eliminated. Purity of discard molasses from 18 days of straight house was 58.59 percent; for the ion exchange period it was 57.41 percent.

Regeneration of cation was two-stage with the use of 4 percent H_2SO_4. Regeneration of anion was one-stage with 5 percent ammonia solution: 20.44 lb. of 66 deg. Be. H_2SO_4 and 11.81 lb. of anhydrous NH_3 were consumed per ton of beets. It is hoped that these figures can be reduced. Beds were backwashed with hot water ahead of regeneration to mitigate exchanger poisoning. Bed maintenance against poisoning by tenaciously-held molecules has been a major problem. Special regeneration techniques, however, have been worked out to overcome this handicap. Juice was cooled to 50 deg. F. by heat exchangers before going to the D.I. unit. Average figures on the thin juice at Layton are:

	To Exchangers	From Exchangers
Brix	12.95	11.81
Sugar, percent	12.13	11.61
Purity, percent	93.76	98.60
pH	8.14	7.13
Invert, percent	0.13	0.36
Non-sugar removal, per cent	.....	77.56

Color developed more rapidly and intensely on boiling D.I. juice than was anticipated in view of nitrogen-removal by the exchangers. This was also observed at the Hardin plant. Color also deposited on crystals from liquors of purity high enough to yield white sugar from a standard beet juice. The second strike sugar was bagged separately because of its greater color. As at Hardin, heating surfaces on the sugar end were kept clean of scale, normally a troublesome item in sugar boiling. Engineering of the Layton plant was by Illinois Water Treatment Co. Exchangers were provided by National Aluminate Corp. and Chemical Process Co.

From Hardin

The Hardin unit of Holly Sugar Corp. was in continuous performance by November 30 and continued to process second carbonation juice until the campaign ended on December 21. All juice from some 36,550 tons of beets was treated by ion exchange during this period.

The plant has four pairs of tanks, each 10 x 10 ft. with spun heads designed for a working pressure of 60 psi. They are rubber-lined throughout, as are all piping and valves which come in contact with sugar solution. Control is by push-button operation of switches which open or close the

Table II—Results of Ion Exchange Use at Utah-Idaho Sugar Co.

	Previous 10-Yr. Average	Previous 5-Yr. Average	1947 Average
Sugar in beets, percent	15.814	15.742	15.050
Purity of beets, percent	84.52	84.36	84.84
Beets sliced, tons	74,474	90,303	91,550
Increase net sugar extraction, percent*	4.04	4.70	.....
Decrease molasses, percent on beets*	1.10	1.22	.....

* 1947 as compared with previous averages.

Table III—Cost Balance for Use of Ion Exchange[1]

	Based on Previous 10-Yr.	Based on Previous 5-Yr.
Labor[2]	$3.90	$3.90
Regenerants	9.90	9.90
Molasses lost (@ $40 per ton)	44.00	48.80
Total costs[3]	$57.80	$62.60
Sugar credit (@ 6½c. per lb.)	79.04	91.96
Net profit	$21.24	$29.36

[1] Values are per 100 tons of beets. [2] Three operators plus two helpers. [3] Not including amortization, maintenance, etc. (see text).

valves through relays, solenoid pilot valves and air pistons. Each tank had 410 cu. ft. of exchanger as a bed 5.25 ft. deep. Regeneration of the cation cell was three-stage with 5 to 6 percent H_2SO_4. Anion beds were regenerated single-stage with 2 percent ammonia solution.

Incoming second carbonation juice was filtered, then cooled through a spiral-type heat exchanger. This gives some of its heat value to treated juice leaving the exchanger cells. It was then cooled to below 20 deg. C. in a tubular cooler using factory supply water. The juice was pumped through a single pair of cation and anion cells to the evaporator without any further treatment. Representative results are as follows:

	To Exchangers	From Exchangers
Brix	12.5	9.6
Sugar, percent	11.0	9.5
Purity, percent	89.6	97.6
pH	9.2	7.5
Conductivity, mmhos	4,325	245
Nitrogen coefficient, arbitrary	126	55
Dilution, percent	.....	13.6
Non-sugar removal, percent	.....	82.5
Nitrogen removal, percent	.....	56
Ash removal, approx. percent	.....	94

In sweetening-on, about 0.6 bed-volume was put through before the brix began to rise; by the time one bed-volume had gone through, a solution of about a full brix was emerging. The reverse relationship held for sweetening-off. At one bed-volume the brix of the effluent began to level off above zero; non-sugars were probably being flushed from the bed by minerals in the raw water.

Minimum quantities of regenerants were not determined because of the shortness of the run. Good results were obtained with 25 lb. of 93 percent H_2SO_4 and 6 lb. of anhydrous NH_3 per ton of beets.

Altered nature of deionized juice created problems, as at Layton, in sugar boiling. This was especially true with low-purity juices, since altered viscosities affected the sugar-boiler's judgment. The white pan grained well. Massecuites spun well in the white centrifugals, but graining on the lower-purity pans gave some difficulty. Increase in invert in the lower-purity liquids arising from boiling difficulties caused some rather high-purity molasses to be discarded.

Darkening which occurred during boiling was surprising in view of the high nitrogen-removal by ion exchange: the Maillard browning reaction is usually assumed to account for this feature. The white sugar was of superior quality, averaging 0.0008 percent ash with an SO_2 content of 0.3 ppm. There was a marked improvement in candy-grade sugar and a rise in the darkening temperature during the candy test. Raw sugars produced from ion exchange sirup were free of objectionable tastes and odors; the same was true of the final molasses. Similar results were obtained at Layton. No figures are available from the Hardin plant on the increase in sugar yield through use of ion exchange. This plant was engineered by the Dorr Co. and exchangers were provided by Chemical Process Co.

Interest is increasing in the possible recovery of non-sugars which are recoverable from beet juices by ion exchange. These not only have a potential value, but their removal would simplify sugar refining since nitrogen compounds cause color formation during boiling.

Byproducts

Glutamine, glutamic acid and pyrrolidone carboxylic acid coexist in various degrees in beet juice. Glutamic acid appears in the Steffens house waste in a dilute solution with considerable sugar impurity that complicates its recovery. In the Western states, some Steffens waste is now concentrated and shipped to International Minerals & Chemical Corp. at San Jose, Calif., for recovery of glutamic acid. However, travel of the acid through the refinery both complicates sugar boiling and causes appreciable loss of glutamic acid.

Glutamine and glutamic acid can be adsorbed on a cation exchanger and stripped with ammonia. Pyrrolidone carboxylic acid is adsorbed on the anion bed and removed by the usual regeneration. Both are thus recoverable in fairly concentrated form.

The more complete the nitrogen removal at the beginning of the process, the less trouble will be had from coloring by Browning reactions. Such colors tend to be adsorbed on sugar crystals; this is enhanced somewhat in high-purity D.I. juice over equally dark standard juices of lower purity. Perhaps the small amount of invert created by deionization causes colors by reacting with nitrogen-containing molecules; these may be akin to those which cause staining of crystals in cane sugar boiling. Heavy liming has always destroyed any invert entering the beet sugar house from inferior beets.

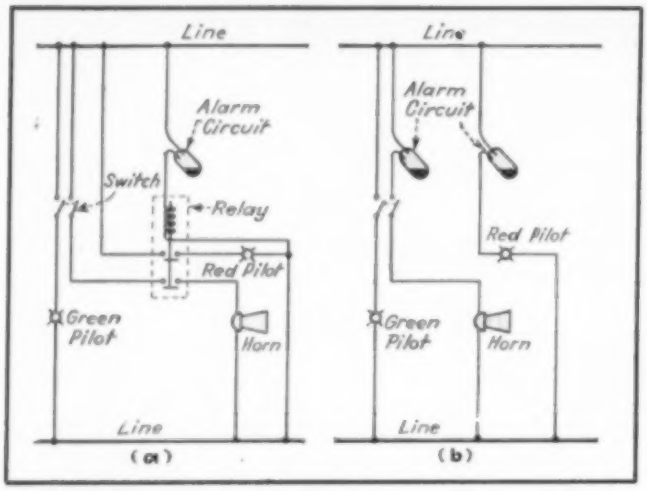
Raw sugars from the low-purity boiling are excellent in quality—free of the odor and taste of beets.

Predefecation

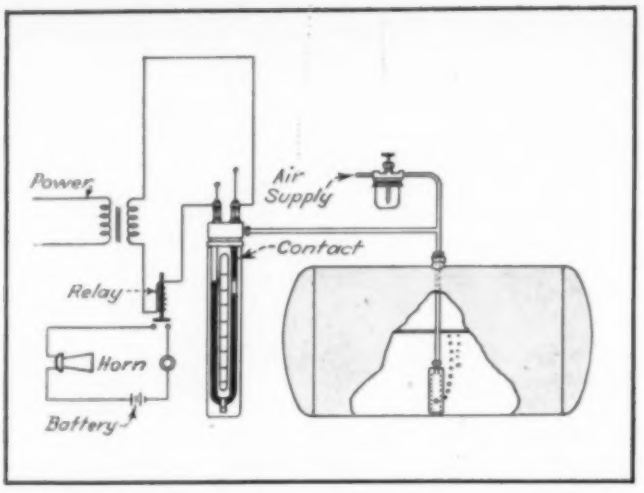
There has been widespread interest in a predefecating technique to replace the present heavy liming and carbonating steps. This would cut down the consumption of limestone and coke, which are expensive. Good limestone is also becoming scarce, especially on the West Coast. One such predefecating technique is that of light liming. In a standard house, an average of 2.3 percent CaO on beets is used but as little as 0.2-0.3 of this may actually be required for clarification; excess lime serves as a filter aid.

If a Steffens house is also operated, then average lime consumption jumps to about 3.6 percent CaO on beets. One of the chief difficulties preventing widespread adoption of light liming is the poor filterability of the slimy predefecation mud. Materials other than lime are now being studied as predefecating agents.

Acknowledgement is made to the following persons and organizations for aid and permission to use data: Lyle B. Porter of Illinois Water Treating Co.; H. E. Ellison of Layton Sugar Co.; E. B. Fitch and J. W. Michener of the Dorr Co.; E. A. Haagensen of Holly Sugar Corp.; E. F. Berry and R. S. Gaddie of Utah-Idaho Sugar Co.; the American Society of Sugar Beet Technologists.



SIGNAL SYSTEMS—A signal system relay energized by the alarm switch (a), or two switches moving simultaneously (b) is used for audible and visible alarms. (Fig. 1).



LIQUID LEVEL—In simple bubbler type detecting device, changes in tank level activate the mercury manometer. Contact with electrode energizes alarm circuit. (Fig. 2).

Emergency Alarms Safeguard

Unsafe or abnormal operating conditions are called to operator's attention by alarm instruments.

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Process control instruments are recognized as necessary to the manufacture of products requiring close adherence to specifications. The human operator is no match for the instruments that detect and correct infinitesimal changes that hardly move the measuring pen or indicator. However, it is difficult to continually watch the chart that is drawing a straight line or the gage that doesn't waver. It is unnecessary to do so if we will give proper consideration to other automatic devices to act as watchmen. As is true of all law enforcement, the cost may look large considering the long periods of inactivity, but the price is small for protection against one outburst of lawlessness or one experience with loss of control.

Whether dependence is placed upon an operator or an instrument to control process changes, the necessity for alarms and shutdown devices to protect against the failure of man or machine is recognized.

For instance, a Hortonsphere may be used as surge capacity on a system between low pressure and high pressure compressors. The high pressure compressors go down due to lack of fuel and the low pressure compressors very soon raise the Hortonsphere pressure to the danger point. A well designed plant would have signals and emergency shutdowns to handle this situation. Consider another case of a large electric furnace operating at about 3,500 deg. F. The circulation of oil to cool the transformer for some reason is interrupted. It is vital to have the operator know this immediately, but not relying upon his reactions, the furnace must be shut down automatically. Although these are selected cases, almost anyone can name similar conditions in his own plant. It is true that most plants have set up alarm systems, but too few have segregated this group of instruments for the special study and periodic testing that their importance deserves.

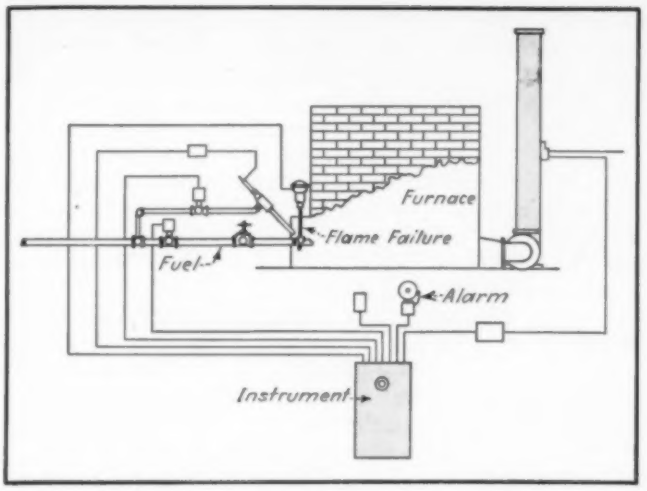
This article should serve as a guide in calling attention to the methods and available equipment for consideration in determining whether sufficient protection exists and to offer suggestions for a testing program.

For purposes of discussion, an emergency instrument is one primarily installed to alarm or to shut down a piece of equipment upon some abnormality in operation of process equipment. Differentiation must be made between this type of instrument and those installed for automatic control of a process, pump, or other piece of equipment. It is evident that, in many cases, the same instrument used for control could be used for the emergency condition. This is not advisable. Much better protection is provided by using another instrument of the same type to identify the emergency condition. Keeping the alarm system entirely separate from the control system helps avoid simultaneous failure.

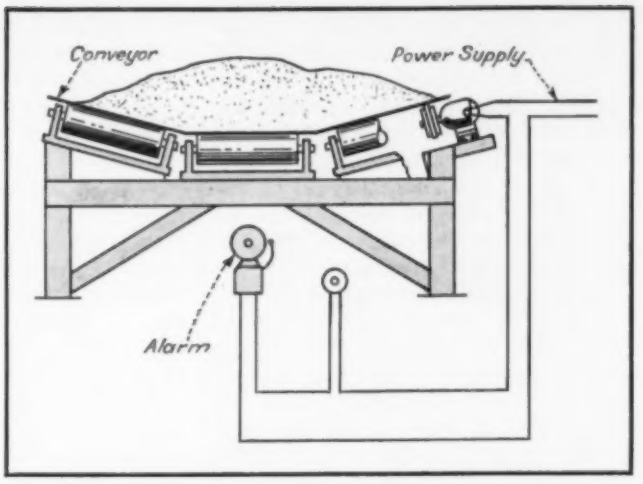
Audible or Visible Signals

Evidence of an abnormal condition is obtained through the use of audible or visible signals. Although horns are available with almost any desired pitch, the use of too many in one location makes it difficult to differentiate between them. One horn placed in a strategic location which will sound at any of the dangerous conditions attracts the attention of the operator. By reference to a signal light or annunciator board, he can locate the trouble.

In the plants of today, the major instruments are grouped on central



FLAME FAILURE—Ionization in the flame completes circuit from electrode to metal burner. When flame goes out, circuit is broken and alarm sounds. (Fig. 3).



MECHANICAL MOVEMENT—When belt conveyor stops, alarm circuit is energized and signal sounds to warn operator of failure of equipment. (Fig. 4).

Plant Operations

panels. This lends itself readily to locating the alarm lights on the board. The alarm system usually grows with the realization of its value; so adequate space should be allowed on the board for expansion. Careful consideration of the location of the alarm panel and horn is very necessary, as seconds count when any of the plant functions go astray.

Types of Signal Systems

The alarm panel may take various forms. Plants having a large number of protected points often use an annunciator with tabs that drop to an open position upon opening or closing the alarm circuit. The location of the actuating instrument is printed on the tab. Lights are most common on the smaller systems. Having the light lit during normal operation and shut off upon alarm conditions has the advantage of the burnt out globe being more readily detected. Another system keeps a closed circuit under normal conditions, but, through the action of an intermediate relay, the light and horn are off. Upon operation of the alarm unit, the relay closes sounding the horn and lighting the light. This system gives some protection against faulty operation of the alarm instrument. The use of two lights for each alarm has decided advantages. By reference to Fig. 1a, it is noted that with an open alarm circuit the green light alone will burn when the switch is closed. When the mercury switch is tilted, it closes the relay contacts lighting the red light and sounding the horn. The horn may be stopped by opening the switch, but the red light remains lighted until the mercury switch is restored to normal position by remedying the emergency condition. Fig. 1b shows the same operation using two mercury switches operated simultaneously. It is apparent that the system selected must be made standard for the plant so that operating personnel will not be confused.

To carry out an alarm or shutdown function it is necessary to have a method of detecting the approach to an unsafe condition. This detecting device must activate the equipment that sounds an alarm, shuts a valve, stops a pump, or accomplishes any other desired function. This is accomplished by the use of electric, pneumatic, or mechanical means. The electric method employs a mercury switch or a circuit breaker operated mechanically. Many shutdown alarm functions require more amperage than can be handled by the detecting instruments. In these cases the switch may operate a relay which has ample capacity.

The operation of pneumatic equipment is, in most cases, made possible by various adaptations of the pneumatic controller. For most alarm applications the control mechanism must be made to give maximum change, or be snap acting, at the set or danger point. At this point a rapid increase in the output air of the controller will close a valve on the line, blow an air whistle, throttle the governor of a prime mover, or complete any of a number of actions.

By now it should be realized that alarm and shutdown systems lend themselves to Rube Goldberg inventions composed of combinations of available accepted products and also composed of innumerable gadgets. The engineer must be careful that the probability of the alarm system becoming fouled is not greater than the chance of correct functioning of the operation he is endeavoring to protect.

Instruments Available

Before considering the personnel and program necessary to do justice to the emergency instruments, it is advisable to summarize the types of instruments under this classification and to discuss their applications. In practically all instruments to be discussed, we could use the same equipment to operate an alarm, shut down a pump, shut down an electric furnace, or complete any similar function. Upon this assumption, whenever the application is for an alarm, we can consider the other uses possible unless otherwise stated.

The same variables that we strive to control with an instrument are the ones that may offer a hazard to life or equipment, if they exceed a maximum or fall below a minimum. We

are, therefore, dealing with the following variables when we select equipment for alarms: (1) Pressure that is excessive or inadequate; (2) loss of level or overflow; (3) temperature that is excessive or too low; (4) flow rates beyond desired limits; (5) electrical circuit characteristics; (6) chemical change beyond process limits; (7) movement of machinery within mechanical requirements.

Many valuable emergency devices, such as relief valves, rupture disks, and vacuum breakers, are not readily adaptable to an identifying alarm, but in practically every application an instrument that alarms upon approach to the operating point of the device can be installed. A study will determine whether it is desirable to give advance notice of this abnormal condition. Steam blowing from the relief valve of a boiler is a common sight which does not cause concern except for the inefficient use of valuable fuel, but popping the relief valve of a hydrocarbon storage tank, even into an adequate recovery system, is a condition that is undesirable. For example, in the operation of a particular plant, any leak or flow from a relief valve would be immediately ignited by the oxidation of finely divided magnesium in the gas stream. In this plant, every precaution was taken not to over pressure equipment.

Pressure Indicators

All accepted methods for indicating pressure may be used as an alarm or shutdown. The bourdon tube, the actuating element of the familiar pressure gage, is very useful. The same movement that normally operates the pointer may be used to tilt the mercury switch, position the flapper of a controller, or operate a switch. For high pressures, the spring or weight loaded piston or diaphragm may be used. Serving extensively for low pressures are the inverted bell, manometer, limp diaphragm, and bellows. When static pressure is exerted on both sides of these instruments, they serve for differential pressure applications.

Many instruments that indicate low absolute pressures accurately are difficult to convert into alarm or shutdown devices. This includes the McLeod or Dobrovin gages and micromanometers. The bellows type absolute pressure element may be used. Necessity has added impetus to the development of measurement methods in the extremely low ranges. Many of these, such as the ionization, Pirani, vacuum tube, or strain gage types, deliver a small voltage. The millivoltmeter or potentionmeter used for translation of this millivoltage to pressure readings may readily be equipped with contactors.

Temperature is the most difficult problem in process control. It is also the most difficult to protect properly in an alarm system. The same rules that apply to thermal element installation for controllers apply to alarms. Inherent lags through thermometer wells and incorrect readings due to improper location are factors that nullify the efficient protection of the equipment.

The bimetallic strip used in many home thermostats makes a very good temperature alarm. Recent equipment of this type has the advantage of not being affected by vibration. This is important in jacket water or oil systems used on engines. Distortion of the helical spring from temperature change is also employed.

Temperature may be measured by a galvanometer type pyrometer, potentiometer, or resistance thermometer, and it is possible to utilize their movement relative to the temperature that is being indicated for operating the alarm. The necessary action may be taken from the rotation of the slide wire contactor, pen-arm shaft, or the rotary or linear movement of the indicator. Pneumatic temperature controllers like those for pressure control are readily adaptable as alarms. The radiation pyrometer may operate high temperature alarms by applying the signaling device to the indicating or recording instrument.

In flow control the most frequent need is for an alarm to show that flow has decreased below a desired minimum. Applications include cooling-jacket water for engines, cooling oil in transformers, air flow to soaking or annealing furnaces, and air flow for ventilating vaults and shafts. A large percentage of measuring devices, especially recorders or those having indicating pointers, may be adapted for an alarm. The intergrating unit, such as a displacement meter, does not adapt itself so readily. For lines small enough to make a pipe-size fitting economical, the area meter is particularly good. Float movement can operate a contact electrically, magnetically or mechanically.

Movement of a check valve can energize an alarm, either by using a shaft from the clapper to a contactor outside the fitting, or by transmitting clapper movement with a magnet mounted on it to a counterpart outside the fitting.

Although there are probably more devices to determine liquid level than any other controllable function, care must be exercised in the selection of the proper alarms. The decision to install an alarm on a tank or vessel must be based upon a determination of the circumstances if the tank runs dry or overflows. An overflow line protects surrounding equipment, but economics demands a notification of this so that the condition can be corrected. Low level can be just as critical as high.

Open Tank Floats

Floats are the simplest devices for open tanks. They can be attached to the end of a rod, ride on a vertical rod, or hang on a counter-balanced chain. The switch may be a mercury or knife type. It is neither good practice nor necessary to try to adapt the vertical-rod device to a totally closed tank.

Numerous assemblies are available that fasten to the tank side. Kidney floats offer the advantages of easy removal for inspection, less agitation at the liquid surface, being out of the way of mixers or agitating lines, and being installed on full tanks. Exercise care in selecting a float. Choose one that stands up best in the liquid, is large enough to operate the alarm, and has correctly designed shafting from inside to switch linkage.

Any of the accepted methods of level indication utilizing the liquid head pressure, either directly or as a differential, may actuate an alarm. These include the air diaphragm or the bubbler, Fig. 2. Changes of level vary the pressure applied to the actuating device.

A differential-pressure instrument compensates for the vapor pressure in a closed vessel because the connection above the liquid transmits the vapor pressure, while the line at the desired depth in the liquid transmits a total pressure equal to the vapor, plus the liquid head pressure. The difference is the liquid-column weight, which may be corrected to linear units for the kind of liquid in the tank. Every differential gage may be used as an alarm, either by using the indicator shaft to actuate a switch or by completing the circuit through contacts in the mercury of a mercury-filled gage. Where hazardous vapors exist, the pneumatic flow controller may operate a remote switch placed outside the danger zone.

Many instruments use the electrical conductivity of a liquid to complete a circuit, or shut-out a coil. Chemical characteristics and flammability factors determine the circuit and type of electrode. Flame-failure devices used extensively on stills and direct-fired

heaters employ: (1) current flow through the flame or (2) an electric eye.

In Fig. 3, control current flows from an electrode in the main or pilot burner, through the ionized flame to the metal parts. Flame extinguishment from any cause opens the circuit immediately. Since ionization caused by combustion closes the circuit, alarm action after flame failure does not wait until the electrode cools, a delay common in many less critical bimetallic alarms and shutoffs. This system is not applicable to liquid fuels, which might themselves complete the circuit.

The electric eye serves for oils and pulverized coal. This instrument focusses a photoelectric tube on the burning fuel or, for gas firing, on an incandescent element in the flame. This control may be set up to alarm simply upon flame failure, or to evacuate the firebox, relight the pilot, and relight the main flame. Speed with which an explosive mixture can accumulate in a firebox is often faster than that at which the firebrick loses its incandescence, and the relatively small investment in flame-failure protection can save thousands of dollars damage and decrease the danger to personnel.

Among the many examples where continued movement of equipment is critical to personnel or process are: (1) an endless belt transporting a product from hopper to kiln or (2) a fan or blower. It may be simpler to signal rotation of the latter two than to detect and sound an alarm for a change in effect, such as differential-pressure loss across a dryer or accumulation of dangerous gas.

One instrument acts like a governor to make or break contact at a critical speed. Contact with the moving equipment accomplishes the desired action, Fig. 4. This method is sometimes more positive than connecting an alarm on the electric circuit to the prime mover. The key in a blower shaft may shear off, the belt break, or other accidents occur, which do not affect continuous movement of the prime mover, but cause decided changes in the equipment.

Movement of a piston- or telescopic-type gas holder becomes hazardous when it approaches the filled or empty position. Here there is essentially no pressure change so some other means of alarm must be used. Trigger switches actuated by arms on the holder's moving part can be located to notify that limits are being approached.

One of the common instruments in chemical processes is for pH control. The complete unit, consisting of potentiometer and cells, is quite expensive, and from an economic standpoint, might justify deviating from the practice of using a separate instrument for the alarm. Alarms for pH are adaptable to such applications as waste water and condensate treatment, and chemical blending. Standard on-off electric units or pneumatic controls may be used as high- or low-limit switches.

Conductivity Alarms

Electrical conductivity alarms are adaptations of the indicating or recording instruments employing conductivity cells as legs of a wheatstone bridge circuit—one containing the standard solution and the other the sample. This alarm is valuable in boiler-water control, possible in leakage of an electrolyte into condenser water, slaking of dolomite.

Thermal conductivity finds application when it is necessary to identify the presence of gas or limit its concentration in a gas mixture. Many industries have to control the atmosphere, or sound a warning if it becomes toxic or explosive. A number of dependable combustible-gas alarms are available. Samples may be drawn from various points into one instrument and an alarm lamp identify the location.

Inspection and Testing

A workable protective installation is not complete unless a procedure for the inspection and actual operation of each emergency instrument is set up in detail and an inspection schedule decided upon. Consider the importance of the operation protected and the possibility of the instrument being thrown out of adjustment. It is difficult to determine the necessary frequency of inspections, as the instrument could become inoperative from external causes immediately after testing. But experience shows that monthly coverage is about right for most commercial instruments.

When testing, simulate actual operating conditions; bring the emergency instrument to the alarm point by manipulation of the equipment being protected. Where this procedure is detrimental to operation, set up a comparable set of conditions to energize the instrument artificially.

To illustrate, compare raising the actual level in an accumulator tank to operate the alarm with the practice of isolating the alarm, which might be a kidney float, and filling it with liquid to operate the alarm. A plugged line from the tank to the kidney would not affect the latter method of testing but would show up in the first method. The latter method would be used to check the level alarm on a fractionating or absorption tower because the level could not be changed readily without upsetting operation.

In addition to a well engineered alarm and shutdown installation and well organized test procedures, it is necessary to administer the test and checking program adequately. The importance of this phase may be emphasized by reference to a recent case in which insurance companies refused to cover a plant only to reverse their decision upon inauguration of a study of existing alarms which resulted in the addition of a very few new instruments and, most important, the assignment of a man to the inspection program. In this case, the man who was responsible for the testing was not selected from the instrument, electrical, or mechanical maintenance departments, so had no inclination towards favoritism in his reports. He was, nevertheless, an engineer with a working knowledge of each department. He was selected for his ability to first, sell the inspection program to the operating department thus obtaining their cooperation in making equipment available to him and, second, for his mechanical aptitude for testing and recognizing potential failure of the alarm instruments. This man transmitted his reports directly to the manager, with copies of the report to the head of each maintenance group. An item on this report showing improper operation of an emergency device was considered an order to the department concerned to remedy the trouble immediately.

Program Administrator

The selection of the man who will carry out the alarm and shutdown program is of vital importance. The type of contact this man makes with the operating personnel can make or break the program. Inasmuch as he is not a member of the operating staff of any of the portions of the plant that he must test, he has absolutely no right to adjust any equipment as called for in his test instructions.

The clear cut identification of the inspection of alarms and shutdown equipment as a separate program has advantages. The importance of a definite test schedule is evident, and the possibility of the schedule becoming confused with some less important maintenance activities is minimized by separating it from the maintenance departments.

EDITORIAL VIEWPOINTS

Sidney D. Kirkpatrick and Staff

Tomorrow's Executives

THERE has been a lot of discussion in recent years of just what a chemical engineering curriculum ought to contain. Many things have been emphasized, as, for example, the need for engineers with ability to express their thoughts clearly and convincingly. Now comes Walter Evans, of Westinghouse, with a different slant.

Evans' thesis is that today's graduating engineers are going to be tomorrow's executives and that their training should properly prepare them for that future.

Evans points out that "prior to the advent of mass production, top-level executives usually came from two professions—they were bankers or lawyers." He indicates the particular abilities that these two professions were able to apply to the management problems of the time. But Evans goes on, "With mass production the engineer came into his own. As industry became more complex, the engineer who understood what was happening joined the lawyers and bankers in administrative positions, because industry had new problems which only the engineer could solve. . . . During the last decade engineers have begun crowding the bankers and lawyers in this contest for high-level administrative posts. So successful have been their efforts that an independent survey published within the last year shows that one-third of the largest corporations in America—50 out of 150—are headed by graduate engineers."

If engineers are to be tomorrow's executives, it is imperative that our engineering schools give training to these future engineers that will head them in the right paths. Admitting that "engineers are inclined by nature to be perfectionists," Evans gives us his idea of the five attributes that mark successful men who move on to high management positions. They are (1) "An ability to express themselves clearly and well; (2) normal curiosity regarding economics, finance, law, psychology, and other non-engineering subjects; (3) a willingness to make the logical and reasonable compromise with perfection which day-to-day business requires; (4) a ready understanding that income must exceed outlay; (5) and above all, an ability to get along with their contemporaries and at least understand their competitors."

If these are the attributes of successful executives, and engineers are to be tomorrow's executives, it is time to examine our engineering schools and see how they are meeting this challenge. When we do, we find that the educational trend is often in the opposite direction—tending toward more and more specialization of training. Today's engineering schools seldom turn out well-rounded individuals. Not often does one meet a young graduate who has broad training in business administration, a general knowledge of patent law, a basic background in finance. This does not mean a rigorous training in such fields, but it does mean an understanding of the broad fundamentals involved.

Evans' opinion is that "Most of today's engineering training accents preparation for strict engineering application with little or no attention given the broader aspects of business administration. . . . Greatest weakness of the present system is this failure to provide good, solid, academic fare which will guarantee a good engineering education *plus* the broader business background which will enable graduates to qualify readily for broader horizons."

What Evans has brought up is a good subject for thought by engineering school deans during the long summer holiday, even for those who will get no rest from academic labors this summer. The fact that today's engineering students will be executives tomorrow is truly a challenge.

Industry, too, has the problem of meeting it. Perhaps another of Evans' statements is indicative: "I firmly believe that the engineer is tomorrow's executive—if he wants the job and if we, as today's engineers, lend our support."

Sensible Assignments

IN CONTRAST with that of some of our Congressional leaders, a higher order of professional thinking is going on at certain levels in the Department of Defense at Washington. A definitely constructive effort is being undertaken for the better utilization of professional personnel, particularly scientists and engineers. One very practical technique is developing.

This work is being done with the reserve officers having technical qualifications and is being guided by Dr. William T. Read, long known for his substantial contributions to personnel problems of chemists and chemical engineers. The result may well be an important change in policy of the military. It can be, if all concerned will get behind the movement.

The effort is to have reserve officers with technical training work on technical problems having immediate or early prospective value for the military services. The men would thereby become acquainted with the career officers of the establishments with which they have reserve connections. They would know the sort of problems on which they might work in the event of a military emergency. And the career men would know where to find needed talent on short notice.

Groups of reserve officers of technical background throughout the country are being given an opportunity to become acquainted with these plans through a series

of lectures and conferences conducted by Dean Read. Those not yet conversant, should take the necessary steps to organize such activities in their own companies or communities. Thereby they can lay the foundation on which to render a good service involving professional talent as well as patriotism, should another military emergency develop.

Mixing Science and Paint

LIKE his distinguished father, Dr. Clifford F. Rassweiler of Johns-Manville, can preach an inspiring sermon when the occasion warrants. Such a setting was provided at the Silver Anniversary banquet of the Paint and Varnish Division of the American Chemical Society. Drawing on his own 17 years of happy, exciting experience as a du Pont researcher in the paint industry, these are the closing words of his very remarkable address:

"This is a 25th anniversary and a time when you should all be proud of what has been accomplished in mixing science and paint and in making science the dominant and controlling factor in that mixture. But it is also an appropriate and fitting time for you to take honest stock of the extent to which the industry has paid only lip service to science.

"It is time for sober satisfaction, but not for self-glorification. There are still many organizations that are trying to take a free ride on the coat tails of the companies who are really applying science to the problems of the industry. There is still plenty of applesauce instead of factual evidence in the selling of paint. There are still millions of customers who are buying second-grade products because the companies supplying them have taken the easy way instead of applying the best technical knowledge to the utilization of modern materials and formulas.

"The industry cannot be made scientific either by simply moving rule-of-thumb methods and thinking into shiny new laboratories or by depending on the efforts of a limited number of leaders. It requires honest scientific effort on the part of every element in the industry. I have been asked to talk about the future of technology in the paint industry. The last 25 years have pointed the way; the future depends upon how conscientiously and how vigorously you pursue it."

A Long Full Life

ON THE desk as this is written is a well-worn copy of a chemical handbook that has been our constant companion for more than thirty years. It is the 1913 edition of the famous "Van Nostrand Chemical Annual," edited by the late Dr. John C. Olsen, of the Polytechnic Institute of Brooklyn. His death at 78 on June 8 brought to an end a career that influenced the lives of untold thousands of chemical engineers who were his students at Poly, Pratt and Cooper Union, the readers who benefited from his many books, and the members of the American Institute of Chemical Engineers which he helped to establish and served for twenty years as secretary before becoming its president in 1930.

By his own choice he continued to teach a few classes until almost the time of his death. His health had already begun to fail in mid-April when he called from his home to urge that some of us carry on for him at the NYU meeting of the Metropolitan Student Chapters of AIChE. Late in May he was taken to the hospital where just a few days before his death he insisted on grading the final examination papers for several of his classes. That he passed them all with his blessing was characteristic of this great, good man.

Dr. Olsen will be sorely missed by all of us. Yet there is something inspiring and challenging in his passing. He died as he lived—after a long full life of unselfish service to the people and institutions he loved. Our own lives are richer because of his great devotion to our profession.

Costly Bungling

ARMY negotiations for disposal of Cactus Arsenal to some chemical company broke down during June. The reasons given ignore one factor of great public concern. This is the question of whether chemical companies can any longer afford to underwrite long drawn-out negotiations with the Army for use of such surplus property.

It took more than five months of what must have been extremely expensive discussion to arrive at only an impasse between Army-engineer negotiators and the spokesmen of bidders representing several groups of highly responsible companies in the process industries. The proposals of the Army were largely impractical for peacetime enterprises. Many seemed to imply that industry can no longer be trusted.

This is highly regrettable, especially at a time like this when stabilized ammonia production should be continued at all available establishments. We do not criticize the Army for zealously trying to protect taxpayers against any raids by selfish enterprise. But this should not be carried to the extreme of making it impossible to do business. It is high time that the military authorities become realistic in their negotiations.

States Take Action

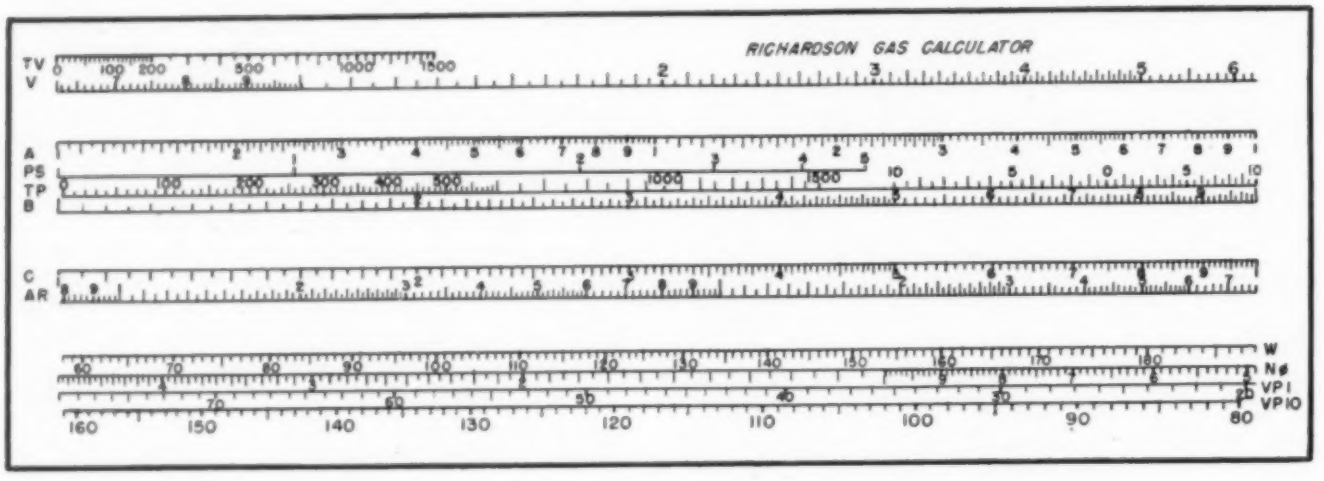
PREVENTION of stream pollution by federal statute and action is not going to be an important factor immediately. This seems to have lulled some elements of the process industries into complacent inaction. We are worried. They should be even more so.

In the last few weeks there has been adequate new evidence of trouble ahead in a series of orders issued by some of the state officials. These gentlemen act with plenty of authority to make their findings effective. If one can find no better motive, there is now threat of prosecution by state officials to insure more adequate action on preventive measures.

We note with concern in one list of 20 firms ordered to cease polluting streams in Pennsylvania, that nearly half are of a sort broadly classifiable as engaged in chemical processing. Perhaps some of these are unwarrantably criticized by the orders given them. We do not attempt to appraise individual actions. But we do venture a generalization. Prevention of stream pollution by chemical enterprise is not only desirable but an absolute essential of technical management today. Longer delay will be serious on the balance sheet.

THE PLANT NOTEBOOK

Theodore R. Olive, ASSOCIATE EDITOR



Slide Rule Solves Gas Flow and Dust Sampling Problems

May Contest Prize Winner

H. RICHARDSON
Research Corp., Bound Brook, N. J.

DURING 14 years of test work in gases I have developed the special slide rule scales shown here for the solution of the more commonly used calculations in making velocity measurements with the pitot tube, in determining the vapor pressure and moisture content of air from the dewpoint temperature, and in finding the proper rate of sampling in dust determinations. The scales permit necessary pressure and temperature corrections, give flue areas directly from diameters and can also be used as an ordinary slide rule for multiplication and division, squares and square roots. As reproduced here the scales do not fit any standard size of slide rule, but they can readily be expanded photographically for pasting on to a 10-in. Mannheim type rule, or a larger one if desired. They can also be mounted on the slide rule blanks that are available for making special slide rules.

As will be noted, the scales are drawn in four groups. Reading from the top, the first and third groups are for the fixed portion of the face of the rule, while the second and fourth groups are respectively for the obverse and reverse sides of the slide.

Below is a summary of instructions for use of the rule. It should be noted that temperatures are in degrees F., with the conversion to absolute temperature taken care of automatically. Pressures are in inches of water column in the case of velocity heads, or in inches of mercury column, in the case of vapor and static pressures. Where necessary, the conversion to absolute pressure is automatic.

How to Use Rule

A. General.

The A, B, and C scales may be used as a standard slide rule for multiplication, division, square and square root relations.

B. Measurement of Gas Flow.

1. To lay out a round flue for a pitot tube traverse in a pattern of concentric circles such that the areas of the four annuli and the central circle are all equal, and find the mean radii of these areas:

a. Set the hairline of the rider on the flue diameter on C scale.

b. Move the left index of the slide to this position.

c. Then 1, 2, 3, 4, and 5 of the PS scale are directly above the distances on the C scale (in the same units as the flue diameter, i.e., ft., in., m., etc.) from the center of the flue to the centers of five concentric annuli of equal area.

In normal practice this gives 20 pitot station locations

June Prize Winner

A $50 prize will be issued to

J. F. Schnacky

Chemical Engineer, Hatboro, Pa.

For an article dealing with a solids discharger for pressure vessels which is the winner of our June Contest. The discharger combines features of earlier equipment for better operation. This is the second time that Mr. Schnacky has won the Plant Notebook Contest.

Mr. Schnacky's winning article will appear in our August issue. Watch for it!

for the reading of velocity heads, in cross-sectioning a flue for the measurement of gas flow.

C. Velocity Head and Gas Temperature to Velocity.

1. Set the hairline of the rider on the observed gas temperature on the TV scale.
2. Move the left index of the slide to this setting.
3. Read velocity in feet per second directly from the V scale for corresponding velocity heads in inches of water on the A scale. (Note: The magnitude of the velocity is on the order of 70 to 130 times the velocity head.) The left half of the A scale is for 0.01 to 0.1 in. H_2O. The right half for 0.1 to 1.0 in. (Any even powers of 10, plus or minus, on the left half, add powers on the right half.)

D. Corrections of Velocity Head for Any Observed Condition so That These Heads as Observed May be Read From the Rule as True Velocities.

1. Pitot factor as a function of velocity.
   a. Set the hairline of the rider on gas temperature on TV scale as under C-1 above.
   b. Move the right index of B scale under this setting.
   c. Move the rider to the left to the pitot factor of less than unity on the B scale.
   d. Move the left index of the slide to this setting and read observed velocity heads in corrected feet per second velocity as in C-3 above.
2. Pitot factor as function of velocity head. Make the correction as above under D-1 on the A scale instead of the B scale.
3. Correction of readings for gas density other than that of air = 1.000.
   a. Set the hairline of the rider on the observed gas temperature on TV scale as above.
   b. Set the observed gas density at this hairline setting on B scale.
   c. Move the hairline to 1.000 on the C scale.
   d. Set the left index of the slide at this position and read corrected velocities as under C-3.
4. Correction for density of gage fluid other than water, or any other condition effecting velocity directly. Correct as above by setting TV reading first, then making the correction on C scale. (Note: These corrections may be combined as continuous steps.)

E Area of the Flue.

1. Move the hairline to the diameter of the flue on C in any units (in., ft., m., etc.).
2. Read the area directly below this setting on the AR scale.

F. Variation of a Volume of Gas for Any Change in Temperature or Pressure.

1. Temperature change.
   a. Set the hairline at the volume on C scale.
   b. Set the existing temperature above this on the left portion of the TP scale.
   c. Move the hairline to the new temperature on the TP scale and read the new volume directly below it on C scale.
2. Pressure change.
   a. Set hairline at present volume on C scale.
   b. Set the new pressure in in. Hg static pressure on the right portion of TP scale (which reads from −10 in. static on the left through 0 to +10 in. static on the right).
   c. Under the original static pressure on TP scale read the changed volume on C scale.

G. Percent Water Vapor by Volume From Dewpoint and Barometer.

1. Pull out slide to the right until the dewpoint temperature (rear of slide) is below the index on either VP 1 (20 to 79 deg. F.) or VP 10 (80 to 161 deg. F.).
2. Read vapor pressure in inches Hg at the left index of the slide on C scale. If from VP 1, the vapor pressure is between 0.1 and 1.0 in. Hg. If on VP 10, the vapor pressure is between 1.0 and 10.0 in. Hg.
3. Above this vapor pressure on C scale set the barometric pressure in inches Hg on B scale and read percent H_2O by volume at the index of the slide on C scale.

H. Amount of Water Necessary to Adjust Moisture Content of Gases, from Observed to Desired Dewpoint.

1. Pull out the slide to the right until the observed dewpoint temperature (between 58 and 188 deg. F.) on W scale on the rear of the slide is below the index.
2. Read pounds of water per pound of dry gas (from 0.01 to 1.0 lb.) on A scale at the right index of C scale.
3. Set the desired dewpoint on W scale as under H-1.
4. Read the pounds of water per pound of dry gas as under H-2. The difference between H-2 and H-4 is the pounds of water per pound of dry gas necessary to make this change.

I. To Determine Rate of Sampling of Gases so That Flow Into Nozzle of Sampler Will Be at Same Velocity as That Measured in Flue at Point of Sampling. Rate of Sampling Corrected for Difference in Temperature and Pressure of Metered Gas as Compared to Flue Conditions.

1. Pull out the slide to the right until the diameter of the nozzle, rear of slide on scale N ϕ, is under the rear index.

Alternate: If no correction is to be made for temperature or pressure, the rate of sampling in cubic feet per minute may be read on AR scale directly below the velocity in feet per second on the A scale (as the A and AR scales are symmetrical, either half of A may be used).

2. Correction for temperature change between flue and meter.
   a. After setting nozzle ϕ as above under I-1 move the hairline to the left index of the slide at the front of the rule.
   b. Move flue temperature to this setting on TP scale.
   c. Move hairline to meter temperature.
   d. Read rate in cu. ft. per min. on AR scale directly below the velocity in ft. per sec. on A scale.
3. Correction for static pressure change between flue and meter.
   a. Correct as under I-2 on TP scale. (Note: Corrections I-2 and I-3 may be combined as a two-step correction.)

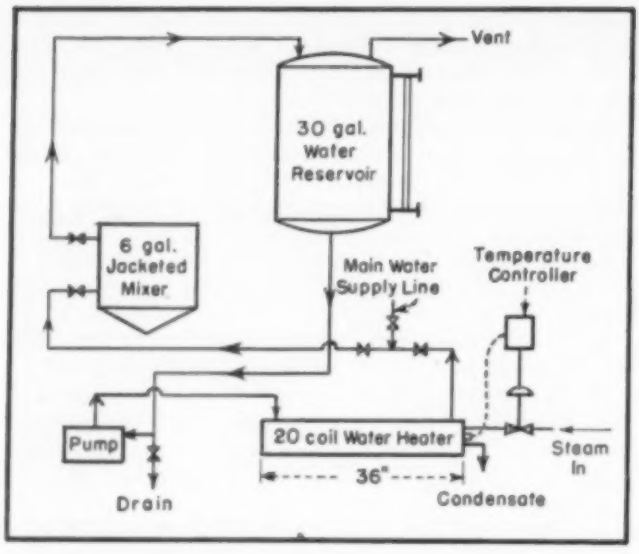
Summary of Instructions

In brief, the scales will give the following from the initial setting:

1. Location of pitot stations from flue diameter.
2. Velocity from velocity head and temperatures.
3. Vapor pressure of gas in in. Hg from dewpoint.
4. Pounds of water per pound of dry gas from dewpoint.
5. Meter rate from nozzle size and velocity.
6. Area of flue from diameter.
7. Change in volume for any change in temperature from 0 to 1,500 deg. F.
8. Change in volume for any change in pressure of ± 10 in. Hg.
9. Multiplication, division, squares and square roots.

With one additional setting the scales will give:

1. Correction for pitot factor, or any observed condition, to read corrected velocities from observed velocity heads.
2. Percent water by volume.
3. Pounds of water per pound of dry gas to change dewpoint.
4. Correction of meter rate for temperature or pressure other than that of the flue.



Temperature Control of Lab Mixer Aided by Circulating Water

ROBERT LURIE
Sylvania Div., American Viscose Corp.
Fredericksburg, Va.

MANY TIMES during pilot plant work it is necessary to carry out small scale mixing processes at constant temperature. An effective, and economical method of doing this is shown in the accompanying sketch. This particular setup was designed to keep the temperature of a jacketed Hobart mixer at 40 deg. C. This was accomplished by merely setting the temperature control at 40 deg. C. The water reservoir, pump, and water heater insure the circulation of a constant supply of water, at a desired temperature, through the mixer jacket. The system may be drained and additional water put into the system by opening the drain lines and the main water line.

Mental Method for Temperature Conversion

WALTER LISOWSKI
Assistant Technical Supervisor
International Graphite & Electrode Corp., St. Mary's, Pa.

IN THE November 1947 Plant Notebook a device for temperature conversion was suggested by B. H. Sanders. This method made use of a diagram. My own method needs no accessories and can even be done mentally in most cases, since it eliminates the mental hazard of trying to multiply or divide mentally by 1.8 and substitutes for it a few little mathematical dodges.

To convert from deg. C. to deg. F., multiply deg. C. by 2, subtract 10 percent of the product, and add 32.

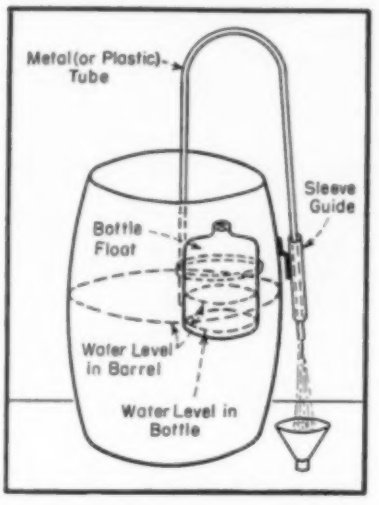
Example 1—100 deg. C × 2 = 200; 200 − 10 percent = 180; 180 + 32 = 212 deg. F.

Example 2—67 deg. C × 2 = 134; 134 − 10 percent = 120.6; 120.6 + 32 = 152.6 deg. F.

The conversion is easily done mentally when round numbers are used. To convert from deg. F. to deg. C. is a bit more difficult to do mentally, but it can be done if an approximate value is sufficient. Here, subtract 32 from deg. F., divide by 9, divide the result by 2, and multiply by 10.

Example 1—212 deg. F. − 32 = 180; 180 ÷ 9 = 20; 20 ÷ 2 = 10; 10 × 10 = 100 deg. C.

Example 2—154 deg. F. − 32 = 122; 122 ÷ 9 = 13.5; 13.5 ÷ 2 = 6.75; 6.75 × 10 = 67.5. The correct value is 67.8.



Simple Siphon Uses Glass Bottle for Float

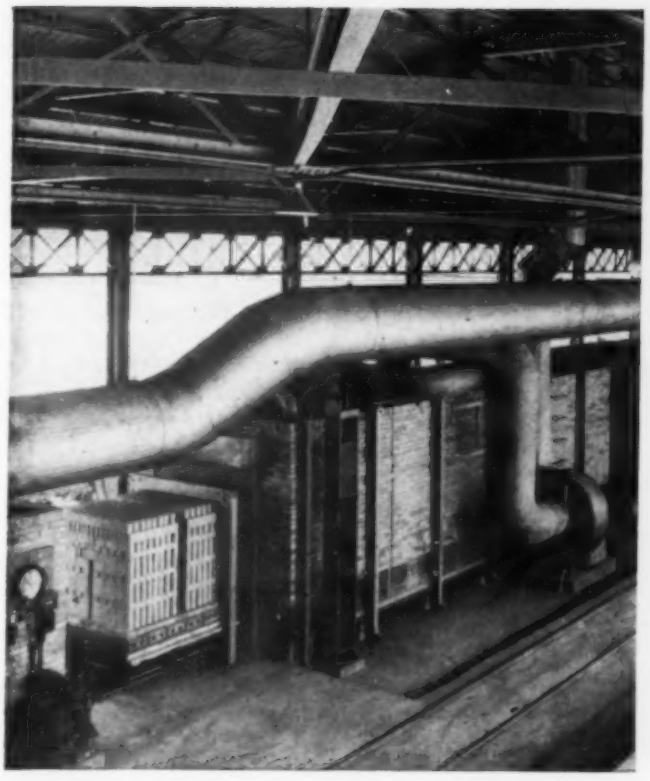
DONALD RUSHMORE
J. & J. Rogers Co.
Au Sable Forks, N. Y.

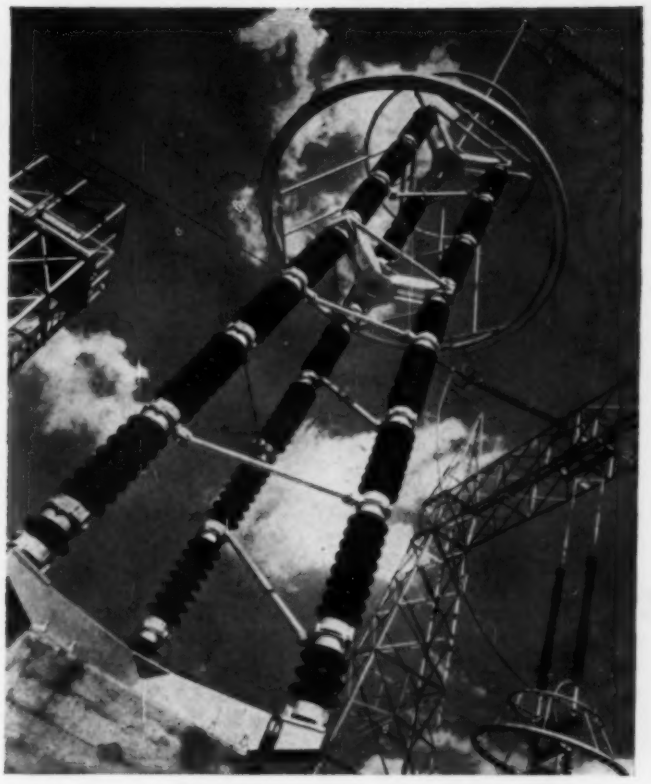
AN INEXPENSIVE constant flow siphon for metering a liquid out of a barrel can be made by bending a piece of metal tubing into an inverted U shape, with one leg slightly longer, and fastening a float made from a large, partially filled bottle on the short end. The outlet end runs through a sleeve made from a piece of larger sized pipe. The sleeve is fastened to the barrel at a slight angle to compensate for the tendency on the part of the tube to fall in that direction due to being out of balance with the float. The desired rate of flow is achieved by varying the amount of water in the float bottle. To start the siphon inject water from a rubber tube into the outlet end of the tube. This device will meter out the contents of one barrel or of any number of barrels hooked in series.

$50 Cash Prize For a Good Idea!

Until further notice the editors of *Chemical Engineering* will award $50 cash each month to the author of the best short article received that month and accepted for publication in the Plant Notebook. The winner each month will be announced in the issue of the next month: e.g., the July winner will be announced in August and his article published in September. Judges will be the editors of *Chemical Engineering*. Non-winning articles submitted for this contest will be published if acceptable at our usual space rates.

Any reader of *Chemical Engineering*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 300 words, but illustrated if possible. Articles may deal with any sort of plant or production "kink" or shortcut that will be of interest to chemical engineers in the process industries. In addition novel means of presenting useful data, as well as new cost-cutting ideas, are acceptable. Address Plant Notebook Editor, *Chemical Engineering*, 330 West 42nd St., New York 18, N. Y.





Mechanized production and improved body compositions, as typified by kiln and insulators above, are the two most important . . .

Recent Trends in the

CERAMIC INDUSTRY

Chem & Met REPORT

WORKING of clay is an art almost as old as man himself. The potter's wheel is a symbol immemorial of man's inventiveness. And it is still a working tool of those who make clay products. But sentiment has not deterred modern makers of ceramics from finding better tools. Hence efficient machines have been put to work today in the ceramic industry. In the manufacture of clay products, science and engineering are playing more important roles. The whole industry has come alive with innovations.

From the mining of mineral raw materials, through the manufacturing stages, to such a diversity of finished products as dinnerware, electrical porcelain, clay construction products, sanitary ware, enamel ware, glass, refractories, chemical stoneware and chemical porcelain, the ceramic industry has chalked up major advances recently.

Among the main currents in the stream of modernization are: (1) mechanized mining of minerals; (2) greater uniformity and better quality of raw materials; (3) bodies of new composition; (4) introduction of such machines as the automatic jigger, the vacuum pug mill, the automatic tile press, the infrared dryer and the continuous tunnel kiln; (5) assembly-line production methods; (6) mechanized conveying and handling; (7) greater emphasis on economy in labor, fuel and materials costs; (8) diversification of products; (9) extension of markets; (10) growth of the industry in the Southwest and West; and (11) emergence of strong, vigorous companies as leaders. Activities of Gladding, McBean & Co., for example, epitomize many of these trends. Highly regarded in the industry, this aggressive, research-minded company is well managed, soundly organized, widely diversified, has mechanized its operations and is a big factor in West Coast production.

Into frit makers' smelters, more TiO_2 for . . .

Porcelain Enamel

RESEARCH is paying off in the porcelain enamel industry. To keep gases from bubbling out, firing temperatures for enamels are being pushed down as low as 1,300 deg. F. With no loss in covering power, enamel coatings are getting much thinner. Even one-coat application is now possible. Fired at the same temperature, ground and cover coats now go through furnaces at the same time. New base metals for enameling are coming in. Sheet iron and sheet steel are replacing cast iron, particularly in sanitary ware. Applications of porcelain enamel in structural products, consumer appliances and industrial equipment have widened markets. In these improvements, such major frit producers as Chicago Vitreous Enamel Co., Pemco Corp., Ferro Enamel Corp. and O. Hommel Co. have led the way.

Use of titanium dioxide as an opacifier in cover-coat enamels is an outstanding recent achievement. These titanium dioxide-opacified enamels possess superior scratch hardness and high resistance to abrasion. They are highly acid-resistant. But it is the exceptional opacity of titanium dioxide that gives these enamels their greatest advantage. Because of it, application weight is cut in half, without loss of covering power. These enamels can be applied in weights as low as 20 g. per sq. ft., thus minimizing chipping, which occurs when enamel coats are thick. And these titanium dioxide-opacified enamels lend themselves to one-coat application.

In opacifiers, there have been other advances. New zirconium frits of exceptionally high opacity have been introduced by Titanium Alloy Mfg. Co. And Titanium Alloy has brought out an improved enamel opacifier containing zirconium oxide. Sodium antimonate has replaced tin oxide as the opacifier in acid-resistant, dry-process enamels that are applied to cast-iron sanitary ware.

Joint development of Inland Steel Co., only present supplier, and Titanium Alloy Mfg. Co., a new sheet steel for enameling permits the long awaited one-coat application. In this steel, titanium is introduced into the metal (in the theoretical ratio of 4 parts of titanium to 1 part of carbon) and the relatively stable titanium carbide is formed, tying up the carbon. Thus the carbon cannot combine with enamel constituents and form gases which would blister the enamel coating. Therefore, it is possible to apply white cover-coat enamels directly to the steel (without a ground coat). Cleaning and pickling of the steel before enameling must be carefully controlled. To insure adherence of the enamel, a thin nickel flash is deposited electrolytically on this titanium steel. The new steel has good drawing properties; it does not develop age strains. Since it does not sag at enameling temperatures, it can be used in lighter gages. Not only does direct application of cover coats to steel speed up production, but it permits use of coatings as thin as 5 or even 3 mils.

Another improvement in porcelain enamels has been the development of special ground coats that can be fired at the same temperature as cover coats. Conveying of ground-coated and cover-coated pieces through the furnace at the same time has greatly simplified production scheduling and has actually increased plant capacity.

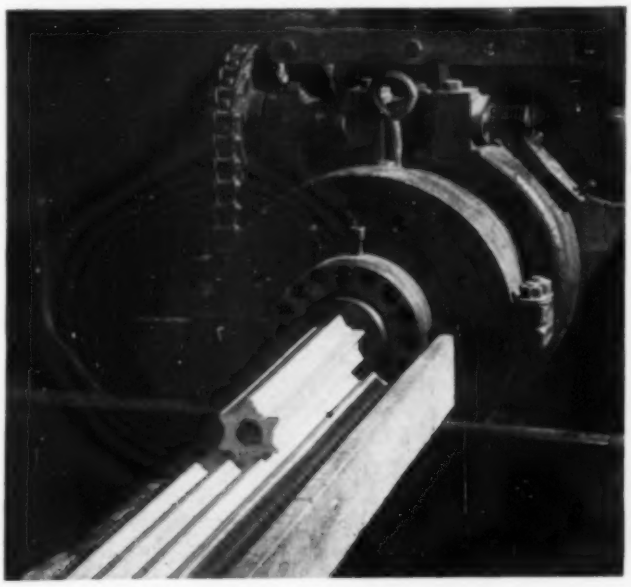
When continuous furnaces, with their short firing time making automatic pyrometers essential, came into the enamel industry, they hastened mechanization. These furnaces are usually of the muffle type, fired on coal, oil or gas (although electric furnaces are coming into greater use). Before enameling, sheet iron and steel are cleaned in boiling alkalis (lately, sodium cyanide) and pickled in sulphuric acid. In the latest continuous machines, the metal articles move on conveyors through chambers where the cleaning and pickling solutions are applied by pressure sprays. For applying wet-process enamels, there is the automatic conveyor sprayer. Even more recent is electrostatic spraying. In this process, the ware passes through an electrostatic field, becoming part of it, and the enamel spray is attracted to the ware. Not only greater uniformity but, more important, thinner application is achieved. Finally, frits for wet-process enameling are now smelted continuously.

Dry-process enameling on cast iron is largely confined to production of sanitary ware. Use of sand slingers and jolt machines for ramming molds, together with mechanical handling equipment, characterizes modern foundry practice. Molds are shaken out mechanically. Molding sand is prepared continuously under controlled conditions. To clean cast iron for enameling, castings on conveyors are passed through automatic sand-blasting machines. Mixing, smelting and grinding of dry-process enamels have been improved by use of tumbling barrels, pyrometric controls on batch smelters and continuous grinding mills.

In recent years, research has sparked progress in the porcelain enamel industry. It has had two goals: (1) to improve the frits that go into enamels; and (2) to provide better steel for enameling. Credit for this program is due the Porcelain Enamel Institute, the National Bureau of Standards, Mellon Institute, the ceramic laboratories of the universities and the laboratories of the frit and steel manufacturers. As a byproduct of this research, new instruments have been designed to measure color, reflectance and adherence.

Most promising market for porcelain enamel is in the structural field. It is used in signs, service stations and store fronts. Now Lustron Corp. will mass produce homes of porcelain-enameled steel (15,000 this year and 45,000 next year). These prefabricated houses will sell at slightly over $8,000. Their manufacture will consume unprecedented quantities of frit. (To satisfy one-third of its 1948 requirements, Lustron has already placed with Chicago Vit a $1,206,445 order, biggest ever in the industry, for 10,578,000 lb. of frit and clay.) And thin spandrel walls

faced with porcelain enamel may soon be used in construction of multi-storied buildings. Despite competition from plastics and organic finishes, porcelain enamel has a growing market in refrigerators, washers, stoves and table tops. (But chipping is still a bugaboo; no satisfactory method of hot patching has yet been devised.) In the industrial field, companies like the Pfaudler Co. and A. O. Smith Corp. turn out lined equipment. Goodyear Tire & Rubber Co. uses porcelain enamel in equipment for making synthetic rubber. Where hydrogen chloride is evolved, as in chlorinating hydrocarbons at 330 deg. F., vessels lined with porcelain enamel give good service.



Better forming of new bodies to go into . . .

Electrical Porcelain

WHEN it comes to new body compositions and better methods of body preparation and forming of ware, makers of electrical porcelain are out in front of the entire ceramic industry. Companies like Westinghouse Electric Corp., Locke, Inc., General Ceramics & Steatite Corp., and Lapp Insulator Co. have been setting the pace. Heavy demand for high-frequency electrical apparatus sparked these achievements. Electrical porcelain manufacturers are meeting stiff requirements set by makers of radio, radar, television and other electronic equipment.

Last word in electrical porcelain are the refractory oxides. These include alumina, beryllia, zirconia, magnesia and thoria, used singly or in combination. Sometimes, clay and fluxes are added. Fired at temperatures above 1,600 deg C., these oxides yield solid solutions or single crystal systems. Costly and difficult to manufacture and fire, the oxide porcelains are the premium electrical ceramics for severe service. During the war, both Germans and Allies used alumina spark plugs in aircraft. Now refractory oxides are going into vacuum tubes and other electronic equipment. These oxide porcelains have superior mechanical, thermal, electrical and chemical properties.

High-dielectric titanates have been a most important development in electrical porcelains. Titanate bodies consist essentially of combinations of barium, strontium, calcium and lead titanates. High-quality titanate ceramics are manufactured commercially with dielectric constants higher than 5,000. These materials have peak temperature coefficients of capacitance and widely variable power factors. In the laboratory, barium and strontium titanates have been prepared, some with dielectric constants up to 20,000. Still other titanates, such as those of iron, copper, vanadium and chromium, as well as reduced titania bodies, are semiconductors and have resistor and other applications. Titanium Alloy Mfg. Co., American Lava Corp., Globe Union Inc. and Champion Spark Plug Co. have led in this work.

Zircon porcelains offer high-frequency electrical characteristics equal to steatite porcelain, possess excellent thermal properties, good chemical resistance and mechanical properties superior to all porcelains except the high-fired refractory oxides. Titanium Alloy has introduced a zirconium silicate for use in these bodies. At high frequencies, zircon porcelains have a low loss factor. Zircon porcelains are expensive to make, as the abrasive zircon causes greater die wear. But they have a better firing range than steatite. Not just in electrical porcelain but in other whiteware, zircon bodies have great possibilities.

Containing less talc than steatite, cordierite has a fairly high alumina content. Outstanding characteristic of cordierite bodies is their low thermal coefficient of expansion, lower than that of alumina bodies. Cordierite porcelain has excellent heat-shock resistance. Since it is dimensionally stable under temperature change, it is used in coil forms for oscillatory circuits. But in dielectric and mechanical properties, cordierite porcelain is surpassed by steatite.

Granddaddy of them all, steatite porcelain is still the ranking high-frequency ceramic. Wartime demand for electronic equipment boosted steatite production. Steatite is mostly talc, with clay and fluxes. Originally, alkaline fluxes like feldspar were used. Today, alkaline-earth fluxes go into steatite, giving it a lower loss factor at high frequencies and improving its electrical properties at elevated temperatures.

In body preparation, the need for a liquid slip can be eliminated by dry mixing. Thus blunging, filter-pressing, pugging and aging can be bypassed. But since it requires fine clays, dry mixing was impossible until producers of mineral raw materials began to supply air-classified clays. In dry mixing, clays, fluxes and flints are mixed without water for a few minutes, and then just the required water is added. Intensive mixers like the Simpson and Lancaster are use. Incidentally, ultrasonics has possibilities in mixing, grinding and forming. It could be used to keep particles in casting slips in suspension.

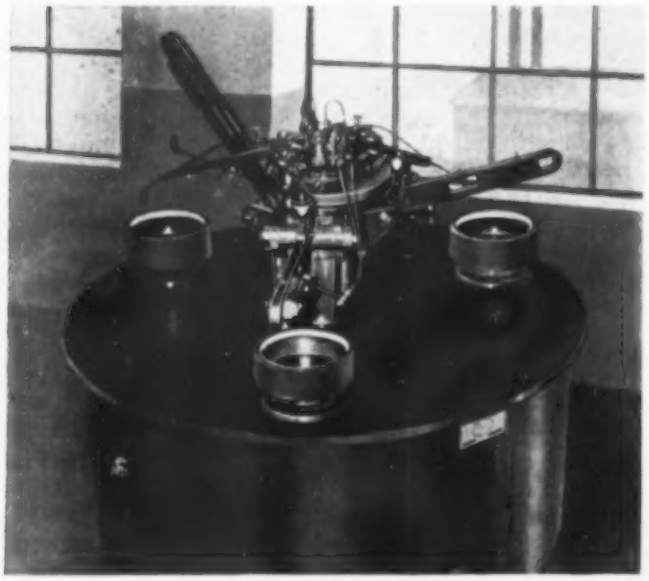
Forming of electrical whiteware has been improved. For plastic bodies, direct extrusion is possible with the vacuum pug mill. Today, the vacuum pug mill, together with auxiliary hydraulic equipment, is used for stiff mud extrusion. This stiff mud contains little water, so drying time for the extruded ware is cut down. By pressure forming in steel dies, intricate shapes are mass-produced. (For workability of bodies containing little water or plastic clay, the binders, waxes, lubricants and organic plastics are added.) Westinghouse employs vacuum pressing with evacuated dies. Dry pressing is carried out in a vacuum press made by F. J. Stokes Machine Co. Even injection molding, borrowed from the plastics industry, is put to work. A thermosetting resin is added to a non-plastic body and the combination injection-molded. Upon firing, the resin burns out and the ceramic body vitrifies.

Safe and rapid, humidity drying is now employed throughout the white ware industry, particularly for ware of large size or thick cross-section. Special continuous dryers for electrical porcelain have reached a high point of usefulness. For circulation, jets are taking the place of fans. New infrared dryers, properly regulated, are giving outstanding

results. Recently, Westinghouse has experimented with dielectric drying.

Continuous tunnel kilns have been universally adopted. Electrical porcelain is fired in both the straight and the newer circular tunnel kilns. Oil and gas have supplanted coal as fuel. Not far off is electric heating. In today's exact firing, not only temperature but draft and atmosphere are controlled by instruments. Open setting, with refractory plates and posts, has superseded use of saggers, further increasing kiln efficiency.

Methods of hermetically sealing metals to porcelain have been devised. Also of interest is the application of silicones to electrical porcelain surfaces. Since the silicones are hydrophobic, high electrical flash-over values are maintained even in humid atmospheres. The ceramic component (silica) insures freedom from arc tracking.



From automatic jiggers, a record flow of . . .

China Tableware

DURING 1947 shipments of china tableware were valued at about $40.6 million. Dinnerware production is being revolutionized by mechanization. Much of this progress is due to the automatic jigger. Other innovations include infrared dryers, automatic decorating units and more conveyor systems. With this improved equipment, the steps in dinnerware manufacture are dovetailed into a continuous operation. Improvements have slashed mold turnover time.

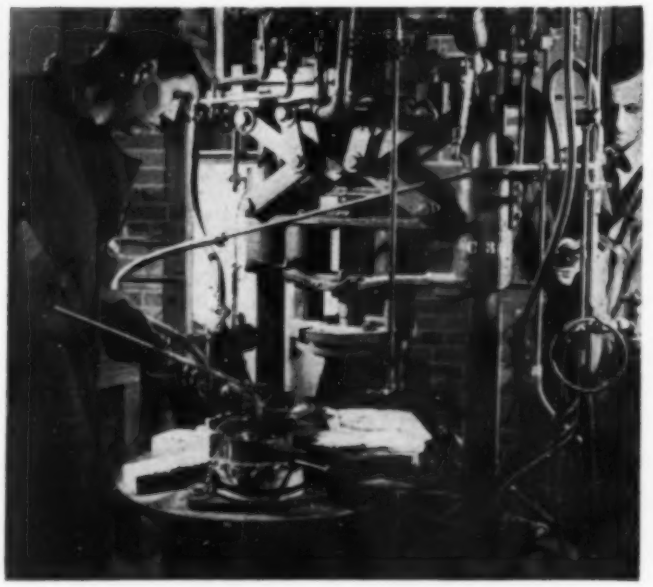
Jiggers enormously increase output; they save time and labor; and they give a more uniform product. In the latest jiggers, dinnerware is formed in plaster-of-paris molds which move through three stations. At the first station, clay is dropped into the mold. At the next station, the mold moves up against a heated die which flattens the clay. At the third station, the mold, then rotating, moves up against a stationary, sharp-edged tool, called a profile, for final shaping. Next, the mold moves through a dryer where the dinnerware item is dehydrated. After the item has been removed, the mold moves back to start the cycle over again. Allen Jigger Corp. of Syracuse, N. Y., and Miller Pottery Engineering Co. of Swissvale, Pa., are jigger manufacturers. Both semi-automatic and automatic jiggers are in use.

Half the country's jigger capacity has been installed in the past two years. Homer Laughlin China Co. of Newell, W. Va., is adding production facilities for about 36 million pieces a year, doubling its present capacity. Shenango Pottery Co. of New Castle, Pa., now has four automatic jiggers. Three of these turn out one item at a time. But the latest installation, put in last year, can produce eight.

To keep up with the increased output of the automatic jiggers, faster drying is essential. So infrared dryers have come into greater use. In some factories, infrared now replaces kiln drying of dinnerware. It permits an accelerated, but properly controlled, drying operation. At the works of Buffalo Pottery, Inc., the Trumbull Electric Mfg. Co. has installed infrared equipment to dry dinnerware. Ware is shrunk from the molds and dried sufficiently for handling in 13 min. Former time in a convection oven was 3 hr. At Shippenville, Pa., the Purinton Pottery Co. also is trying out infrared dryers. Infrared saves space and speeds drying. But these advantages are not invariably reflected in dollar savings.

Spraying machines now apply glaze as the ware moves along on a conveyor belt. Formerly, the plate was dipped by hand into a solution. Machines to decorate the ware replace operators using hand brushes. Semi-automatic edge-lining machines, for example, apply gold and platinum bands. Shenango Pottery recently added five automatic edge-lining machines.

More conveyors are being used in dinnerware production. Homer Laughlin is installing new conveyor systems in its plant. The Edwin M. Knowles China Co., also of Newell, W. Va., is rearranging production lines.



Out of the laboratory, new compositions in . . .

Glass

ACME of mechanization, the glass industry turns out an enormous volume. Here is its 1947 record: it produced 115.3 million gross of glass containers (more than

double the prewar 1939 output of 53 million gross); it turned out about 1 billion sq. ft. of window glass; it manufactured more than 252 million sq. ft. of polished plate glass; and it shipped over 107 million dozen items of machine-made glassware. Even more impressive than its prodigious output are the glass industry's latest technical developments.

Out of the trinity of minerals, machines and heat has come the inorganic fiber. A product of research (since 1932, Owens-Corning Fiberglas Corp. has put about $20 million into research and development), glass fiber competes successfully with vegetable, animal and other synthetic fibers. (Fiberglas materials made in its U. S. plants netted Owens-Corning $41 million in sales last year, up 25 percent over 1946.) Flexible, with a high strength-to-weight ratio, and non-combustible, glass fiber resists weathering, rot and chemical action. It is dimensionally stable. Moisture cannot shrink, stretch or swell it. Thermal-acoustical insulating properties of glass fiber are outstanding. For plastics and textile fabrics it has opened new vistas. A new Owens-Corning plant is under way at Santa Clara, Calif., and Fiberglas Canada, Ltd., a subsidiary, is building another new plant at Oshawa, Ontario.

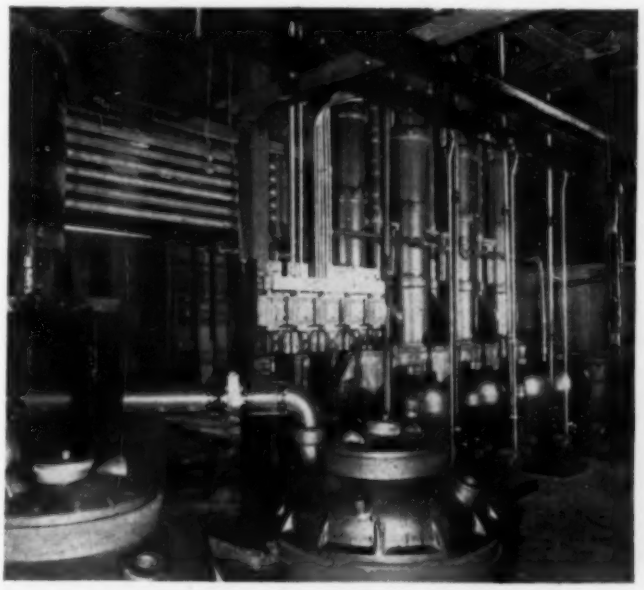
For industrial, marine and jet-aircraft applications, a removable Fiberglas insulation, light in weight, has been developed to withstand temperatures up to 1,800 deg. F. Super-fine fibers (average diameter, less than 0.00009 in.) go into thermal-acoustical materials for aircraft. Glass-fiber wedges deaden sound in test chambers at Bell Laboratories and at Harvard's Electro-Acoustic Laboratories. To strengthen the protective coating (of hot tar, asphalt or wax) applied to a pipeline going underground, a Fiberglas mat is wrapped around the pipe while the coating is still soft. Dyed Fiberglas yarn can now be coated with a transparent plastic film of vinyl resin. This gives it resistance to abrasion. Low-pressure plastic laminates, when reinforced with glass fiber, possess extraordinary strength for their weight.

Five groups of glass have made greater progress recently than ever in their history. These are: (1) high-silica glasses; (2) borate glasses free of silica; (3) phosphate glasses; (4) silicate glasses free of alkali; and (5) glasses with new properties due to combination of oxides. Rapid growth of the electrical and optical industries stimulated these advances.

The Vycor process provides an ingenious method for the manufacture of high-silica glassware from a glass easily melted and shaped by normal methods. This alkali-borosilicate glass offers no difficulties in pressing or blowing. Its heat treatment at 550 to 650 deg. C. brings about a phase separation, leading to a slight opalescence. The leaching process requires high homogeneity of the ware. Vitrification of the leached product affects size but not shape. This unique method is unprecedented in glass technology.

Glass is penetrating rapidly into many fields. The Corning Glass Works has perfected a glass with photographic properties on which the latent image is produced by ultraviolet radiation and developed by heat treatment. The ultraviolet radiation precipitates gold and silver colloids. Both Pittsburgh Plate Glass Co. and Libbey-Owens-Ford have developed treatments which make the surface of glass a conductor for electricity. Libbey-Owens-Ford employs a stannic oxide coating on the glass. Thus glass plate can be used as a heating unit. Airplane windows, for example, are kept free of fog and ice.

Most profound changes are taking place in the field of optical glass. From original glass compositions containing soda, lime and silicate, every single element has been displaced by other elements. Eastman Kodak Research Laboratories took the last step when it produced on a commercial scale optical glasses that do not even contain oxygen. Nor do these glasses contain any of the other three original glass-forming elements, silicon, calcium and sodium. The Eastman Kodak glasses are derivatives of beryllium fluoride.



Into chemical plants, better vessels of . . .

Chemical Ware

In 1941, output of chemical stoneware process equipment was valued at $1,190,000; by 1947, its value had reached $2,640,000. A small but thriving industry, the manufacture of chemical ware and porcelain requires specialized know-how. This requirement deters newcomers. So three companies (General Ceramics & Steatite Corp., U. S. Stoneware and Maurice A. Knight) dominate the industry. To their customers, they can deliver complete processing units.

There is no unique stoneware body for universal application. For manufacture of high-concentration hydrogen peroxide, for example, a dense body free of surface iron is required, while for chlorine production, the body can be somewhat porous, but it must resist temperature change and have high heat conductivity. Research has produced the silicon carbide, cordierite, metallic silicon and mullite bodies.

Metallic oxides and silicates (ZrO_2, Al_2O_3, $ZrSiO_4$) are replacing plastic clays in bodies for chemical ware and porcelain. General Ceramics has developed a mullite-zircon porcelain-type body that combines whiteness and strength. Dense, highly vitrified and thermal-shock resistant, it can be made into large shapes.

Cordierite, a double silicate of magnesia and alumina, has an exceptionally low coefficient of thermal expansion. Cordierite ware will take thermal abuse. It has almost zero absorption, is strong and, due to its alkaline composition, resists alkalis.

Silicon carbide bodies surpass regular stoneware bodies by more than 300 percent in thermal conductivity. Silicon carbide ware has low porosity, can be glazed brown or

white and, despite its extreme hardness, can be machined and ground. Its high tensile strength makes it easy to handle in the unfired state. Thermal-shock resistant up to 400 deg. C., it is used in stills, condensers and heat exchangers.

A stoneware body with zero absorption that will withstand temperature changes encountered in electrolytic dissociation is now used in place of expensive porcelain in cells for solutions of gold, palladium, rhodium and other precious metals. A pure white stoneware, also with zero absorption and with a brilliant white glaze, developed specifically for the rolls of skein dyeing machines, has been found useful in equipment for manufacture of pharmaceuticals and C. P. chemicals.

In this industry, everything is built to the customer's order. This fact, together with the diversity of shapes and sizes produced, has hampered mechanization. Since pieces of many different sizes and shapes can be fired in it economically, the coal-fired, down-draft kiln is still used. But since research has shown that the traditional salt glaze is not the one ideal finish for ceramics and since other glazes cannot be applied economically in the coal-fired kiln, two American stoneware plants have gone over to oil firing in their new kilns. There is, moreover, a tendency to go far beyond the traditional kiln temperatures, particularly in firing ware of high heat-shock resistance.

In clay body preparation, some up-to-date machinery like the Simpson intensive mixer is used. Vertical vacuum de-airing machines make pipe and tower sections; automatic presses turn out tower packings (Berl saddles and Raschig rings); improved grinders have been installed. Otherwise little radically new equipment has been added.

When it comes to size, makers of chemical vessels have "gone about as far as they can go" in one-piece construction. High shrinkage and difficulty of handling before firing make it impractical to construct vessels much greater than 800 to 1,000 gal. in capacity. Larger units are made by joining separate pieces or by putting ceramic linings (acidproof brick, for example) into equipment built of metal, concrete or brick. Weak spots in such construction, of course, are the cemented joints. To strengthen them, new cements containing furane resins have been developed.

These thermosetting furane resins can withstand temperatures as high as 380 deg. F. They resist most chemicals, including caustic and hydrofluoric acid, which stoneware cannot withstand. Reinforced with Fiberglas, they are used as a protective armor on stoneware equipment and piping. Exploitation of these resins, as well as vinyls and chlorinated rubber compounds, has led U. S. Stoneware and Maurice A. Knight into a profitable diversification in the fields of plastics and industrial coatings.

Before the war, chemical porcelain equipment could be had only in certain shapes and in small sizes (maximum diameter in porcelain pipe, for example, was 8 in.). Now porcelain equipment can be secured in almost as many shapes and sizes as stoneware. General Ceramics has produced a 42-in. diameter tower section. In the U. S., General Ceramics has pioneered the production of porous porcelain diaphragms of controlled pore volume. Made by casting, these diaphragms go into electrolytic cells for production of hydrogen peroxide. Concentrated hydrogen peroxide is part of the fuel in rockets. Recently, AEC has called upon manufacturers to construct a huge porcelain "doughnut" for a new 60-ft. cyclotron.

Both U. S. Stoneware and General Ceramics have introduced pipe and fittings with cemented-on cast-iron or mechanite flanges. Stock sizes of pipe can be cut to any length and standard ASME flanges can be used. These are advantages over conical flanged pipe.

Domestic chemical industry is still their best customer, but since the war U. S. manufacturers have been shipping chemical ware to Latin America and Europe. Postwar difficulties have hit Europe's chemical ware plants. Only one big German stoneware plant, its production crippled by shortages, is intact outside the Russian zone; its products no longer meet American standards. ERP will keep Europe's orders coming until she recovers, then this market will dwindle. But Latin America will continue a good customer. To fill these foreign orders and to meet the demands of the growing U. S. chemical industry, present chemical ware plants are running at capacity and moderate expansion is under way.

From tunnel kilns, to feed the building boom . . .

Structural Clay Products

THE STRUCTURAL clay products industry is riding the crest of the construction boom. Many marginal producers are being carried along on the wave. But the smart companies, with an eye on the future, are anticipating the hard landing on the rocky beach when the building boom breaks. They are modernizing their plants. Time is on their side. Already, there are fewer but better plants and fewer but stronger firms, with a greater market and a larger total output. Meanwhile, production continues all-out.

In 1947, 5 billion unglazed bricks were produced, the highest output since 1930. The production of 1.3 million tons of unglazed structural clay tile established a new record in 1947. Unglazed and glazed hollow facing tile produced in 1947 totaled 309 million brick equivalents, up 12 percent over 1946; for the combined group of unglazed and glazed floor and wall tile and quarry tile, 1947 output was 89 million square feet, up 44 percent over 1946; and for drain tile, 713 thousand tons, up 53 percent. Highest annual output since 1929 was last year's production of 1.4 million tons of vitrified clay sewer pipe.

Long a laggard in technology, the clay construction products industry is waking up. High labor costs have accelerated mechanization. Discernible trends are: (1) employment of dry mixing; (2) vacuum de-airing; (3) use of

hydraulic extrusion presses; (4) controlled and mechanized drying in humidity dryers; (5) firing in continuous car tunnel kilns and (5) handling by mechanical equipment.

In making terra cotta, due to the variety of shapes and large sizes fired, continuous tunnel kilns cannot be used. At its Perth Amboy, N. J., plant, Federal Seaboard Terra Cotta Co. has oil-fired periodic kilns, each with an 80-ton payload and a 15-day turn-around. Federal Seaboard also employs vacuum extrusion, extruding pieces up to 4 ft. long and 26 to 30 in. thick.

Vacuum extrusion is now also widely used in making brick and tile. Fate-Root-Heath Co. and International Clay Machinery Co. make vacuum de-airing machines. International has just introduced an all-welded extrusion machine with a single shaft.

Until recently, sewer pipe was made on vertical steam presses. Now, hydraulic presses, permitting higher forming pressures and quick cut-off, are coming in. Driven by motors hydraulic presses eliminate the need for steam-generating plants. One of the first hydraulic sewer pipe presses installed is at the Pacific Clay Products Co. plant on the West Coast. Sewer pipe in lengths up to 8 ft. is now being made, and several novel methods of joining pipe have been devised.

The automatic tile press has been a big boon to tile production. One automatic wall tile press can turn out 35,000 wall tiles in an 8-hr. day. Gladding, McBean & Co. in California, American-Franklin-Olean Tile Co. in Pennsylvania and Robertson Mfg. Co. in New Jersey have installed such presses. Today, much thinner tile is being produced than in the past. To a great extent, single firing is employed. Less lead and more frit is being put into glazes for tile. And, thanks to closer control over raw materials and firing, the problem of crazing has largely been licked.

For service at ever higher temperatures . . .

Refractories

CERAMICS and combinations of ceramics with metals ("cermets") have a big future as coatings, refractory linings and molded parts for gas turbines, jet engines and rockets. Boosting the thermal efficiency of these new power plants calls for greater compression ratios and ever higher temperatures. High-temperature materials must operate for reasonable periods in gases at temperatures from 1,800 to 5,000 deg. F. Most metals soften below these temperatures. But the cermets retain strength, resist chemical action and withstand heat shock.

U. S. Air Force's Air Materiel Command is sponsoring a broad research program, with Illinois, Ohio State, Penn State, New York College of Ceramics, Rutgers, Battelle Memorial Institute and Armour Institute participating. The program seeks to develop: (1) high-temperature ceramic bodies; (2) refractory coatings for metals; (3) furnaces for firing materials at temperatures from 2,000 to 5,000 deg. F. or higher; and (4) accurate methods of measuring temperatures above 3,000 deg. F.

Ceramics under study for high-temperature applications include metallic oxides (Al_2O_3, Cr_2O_3, BeO, ZrO_2, ThO_2) alone or in combination; metallic oxides bonded with metals; carbides, nitrides and borides of such metals as iron, chromium, nickel and cobalt bonded with metals and alloys; fused alumina and silicon carbide; silicon carbide bonded with graphite; graphite with metals; graphite or carbon; and plaster-of-paris and graphite mixtures that decompose endothermically, providing transpiration cooling. Both vapor-phase and mechanical impregnation of coatings, as well as capillary intrusion of the molten metallic phase into pre-fired ceramic bodies, are being investigated. Coating applications by electrolytic means, electric osmosis, spraying, dipping, vaporization and atomic hydrogen fusion are being explored. Coatings are usually fired on. Solid ceramics are sintered, cast or transfer-molded.

Basic brick made of chrome-magnesite is replacing much of the silica brick in open-hearth furnaces. Both burned and chemically bonded brick are produced. (Harbison-Walker Refractories Co. makes both; General Refractories Co. makes chemically bonded brick; and E. J. Lavino & Co. specializes in burned brick.) Of the 944 open-hearth furnaces in the U. S., 19 already have all-basic ends and another 11 will have them by next year. At its South Works, Carnegie-Illinois has built an experimental all-basic open-hearth furnace. Chrome-magnesite lasts longer than silica brick; it permits higher operating temperatures. With it, suspended construction replaces sprung-arch construction, cutting time and costs for installation and repair. When basic brick is used, less slag is formed; the slag is friable and can be shoveled out without dynamiting. Another development has been the installation of carbon hearths in about 35 blast furnaces. Extremely refractory, carbon is volume stable. It can stand temperatures (from 2,700 to 3,000 deg. F.) encountered in iron smelting.

Super-duty silica brick, in which the total content of alumina, titania and alkalis does not exceed 0.5 percent, can withstand temperatures up to 3,100 deg. F. Made by Harbison-Walker, it is used in open-hearth furnaces, electric furnaces and glass tanks. There is a growing use of forsterite refractories in glass tanks. Stabilized zirconia, made by Titanium Alloy Mfg. Co., is an outstanding new refractory with exceptional thermal-shock resistance. Babcock & Wilcox Co. now makes insulating firebrick for use limits up to 2,900 deg. F. Used chiefly in furnaces for heat-treating and forging, it is also in demand for refinery heaters. Babcock & Wilcox has developed a 3,000 deg. F. refractory castable. And B&W has reduced installation labor costs with its refractory castables that can be gun-sprayed. These line and cover boilers, furnaces, stills and refinery heaters.

In the refractory industry, about 80 continuous tunnel kilns have replaced periodic kilns. Fired on gas, oil or coal, tunnel kilns provide controlled heat treatment, rapid firing,

fuel economy and better product quality. They have reduced labor costs. For continuous firing in tunnel kilns, much credit goes to Dr. J. T. Robson of Ferro Enamel's Allied Engineering Division. In the West and Southwest, where gas fuel is cheap, rotary kilns now calcine base materials. B&W has long calcined kaolin in rotaries. Harbison-Walker calcines diaspore and flint clay in rotary kilns at its Fulton, Mo., fireclay and high-alumina brick plant. LaClede-Christy Clay Products Co. of St. Louis, Mo., and A. P. Green Fire Brick Co. of Mexico, Mo., also use rotary kilns.

For dry-pressing non-plastic, silica and high-alumina brick, pressures as high as 10,000 psi. are employed in the heavy-duty brick press. Eliminating hand-molding of large and intricate refractory shapes, the hydraulic press does a smooth forming job, delivers specified grain size, cuts drying time and avoids deformation in handling. Another press offers a completely controlled pressure cycle. A new machine sizes insulating firebrick mechanically. Completely automatic, it reduces labor costs to one-fourth what they were when hand-grinding to size was used. In materials handling, mechanization is the order of the day. Bulk handling of raw materials requires special weighing equipment. Palletizing is increasing, calling for more lift trucks. In the plant, brick is handled in bulk. New tool for production control and research is the spectrograph.

Modernization and expansion in the refractory industry (which shipped products valued at $153 million in 1946) goes on apace. General Refractories is building a research laboratory in Baltimore; Harbison-Walker has increased its research facilities by 50 percent. At Plymouth Meeting, Pa., E. J. Lavino is putting up a new unit with pilot-plant and research facilities. Babcock & Wilcox has doubled its prewar capacity. Since 1941, Harbison-Walker has been allocating $5 to $7 million a year to new plant (last year it reported $6.25 million in new construction). Expansion in the West and Southwest has been rapid. At Troop, Tex., General Refractories has a modern, tunnel-kiln, firebrick plant. At Athens, Tex., Harbison-Walker has a new plant making super-duty silica brick.

By conveyor casting, mass production of . . .

Sanitary Ware

DURING 1947 manufacturers shipped plumbing fixtures valued at $186,958,884. This is more than a 50 percent increase over 1946 shipments. Plumbing fixtures made of vitreous china, with shipments valued at $57,738,413, accounted for 31 percent of the total dollar volume for 1947. (Value of vitreous china plumbing fixtures produced in 1939 was $22,105,454.) Among manufacturers of sanitary ware the Big Three are Crane Co., Kohler Co. and American Radiator & Standard Sanitary Mfg. Corp.

Chrome plate has replaced ceramics in brass plumbing fittings. But vitreous china completely controls the market for flush tanks. Sale of vitreous lavatories, moreover, is limited only by the industry's production capacity.

In sanitary ware plants with liquid batching facilities, clay is put into slurry form as soon as received. The slurry is stored in tanks until used. This makes possible individual treatment of each clay and permits more accurate batching of the body composition. Universal Sanitary Mfg. Co. uses liquid batching.

To the manufacture of sanitary ware, the Briggs Mfg. Co. has brought its experience in metal fabricating. At its Detroit, Mich., plant, bathtub sump draw is done in a single operation on a 1,500-ton Clearing press. A second press forms the serrations in the tub bottom that prevent slipping. On the sink line at Briggs, a two-compartment unit is drawn from a single blank.

Casting has been streamlined. Casting methods at Universal's New Castle, Pa., plant (where the "Iron Horse" has become famous) and at the Eljer Co.'s Ford City, Pa., plant are typical. When casting molds began to ride on conveyors, sanitary ware went into assembly-line production. This has permitted proper tooling-up for each operation, better dust elimination and installation of mold dryers. With mold dryers, molds can be used more than once a day. Floor space is used more efficiently. Their labors lightened, casters turn out more ware per man-hour.

In the past, bisque and gloss firings were two separate operations. Minor clay cracks were repaired after the first firing and before the glaze was applied. But the two firings were costly and time-consuming. Now bisque and gloss firings are combined in most plants making vitreous china fixtures. A feldspathic glaze is used instead of the softer lead glaze employed in the two firings. This results in a more intimate bond between body and glaze, and it gives a harder, easier-to-clean surface. Single firing requires good workmanship and close process control, but it cuts manufacturing costs.

Drastic reduction in firing cycles marks another big advance. Better technical knowledge and control, plus elimination of unnecessary thickness in the ware, are the most important factors. Firing cycles employed in tunnel kilns today would be impossible without the new super-refractories for kiln cars. Today's firing cycles, in some cases, are below 35 hr.

Casting has replaced hand-pressing. Tunnel kilns are in almost universal use. (The four 3-deck tunnel kilns at Eljer's Ford City plant are 450 ft. long, the longest in the industry.) These advances have greatly reduced costs and enormously increased production. But floor space in sanitary ware plants is now at a premium. So humidity dryers, such as those made by Proctor & Schwartz, Inc., are in greater use. To shorten the drying time further, some plants are turning to infrared dryers.

THESE TROUBLEMAKERS

IN PLANTS EQUIPPED *with*

CASH STANDARD *Streamlined* PRESSURE TYPE 1000 **REDUCING VALVES**

THESE *Users* TELL WHY . . .

A Conditioning Corp. writes—

"Had a very critical job where it was important to HOLD CONSTANT PRESSURE TO VERY CLOSE TOLERANCES because we were using steam to reheat air to a set degree with allowed variation of less than one degree. Changed pressure reducing valves twice, then tried a CASH STANDARD Type '1000' and were able to accomplish the job."

A Maintenance Engineer says—

"I would be more than willing to recommend the performance of the CASH STANDARD Type '1000' Pressure Reducing Valve because we used the valve here UNDER ADVERSE CONDITIONS and found it PERFECT IN EVERY WAY—TROUBLE FREE and PRACTICALLY NO MAINTENANCE COSTS."

A Supt. of a Public Utility says—

"We operate a CASH STANDARD '1000' valve reducing steam pressure from 400 to 175 lbs. on our low pressure steam turbines' condenser air ejectors which is an important function and it has done the job WITHOUT FAILURE TO DATE."

A Tobacco Co. writes—

"We use only one '1000' valve in this department. It is used on the steam line to our Castle Autoclave (tough service). Our experience has been CONTINUOUS SMOOTH OPERATION for several years."

An Instrument Co. writes—

"Control of gasoline pressure on flo range of 5-4000 p. p. h. at 17½ psi. CONSTANT PRESSURE CONTROL over full range within 5%. This was on production test stands used for checking solid fuel injection on aircraft motors."

WRITE FOR BULLETIN 962

Note the benefits users say they get from their CASH STANDARD Type '1000' Pressure Reducing Valves.

Check the benefits with this list

1. **Maximum capacity when needed most.**
2. **Accurate pressure control under toughest working conditions.**
3. **Trouble-free service.**
4. **Smooth operation.**
5. **Tight closure.**
6. **Speedier production results.**
7. **Elimination of failures.**
8. **Cost-saving operation.**
9. **No spoilage.**
10. **Practically zero in maintenance.**

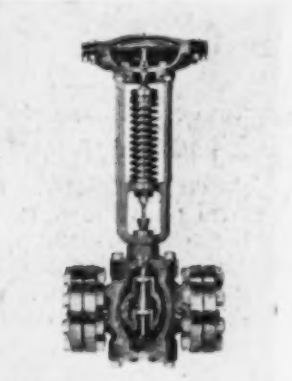
CASH STANDARD CONTROLS . . . VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

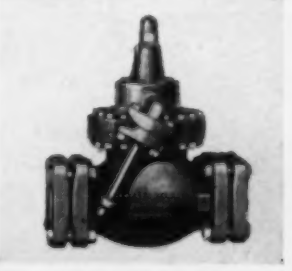
BULLETINS AVAILABLE ON OTHER CASH STANDARD VALVES

Send for them

Bulletin 963 features the CASH STANDARD Type 100 Series of Super-Sensitive Controllers — various types for automatically operating valves, dampers, rheostats, stokers, pulverizers, fans, and other apparatus. 16 pages filled with descriptions and applications.

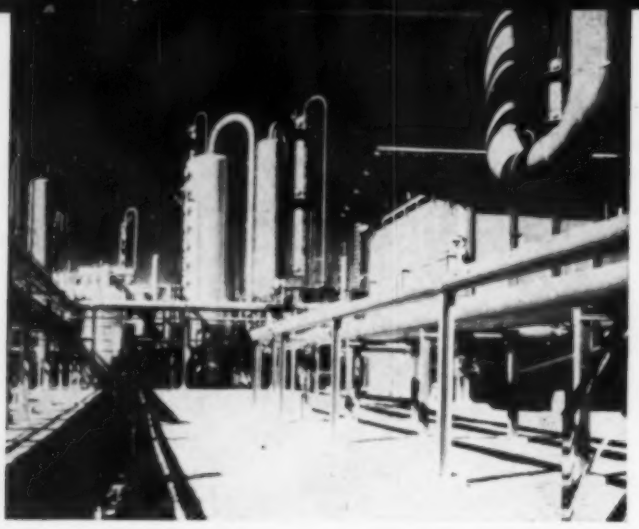


Bulletin 968 features the CASH STANDARD Type 34 Pressure Reducing Valve — direct operated — direct acting for handling steam, hot water, cold water, air, oil, brine—and most liquids and gases except some injurious chemicals. Illustrates and describes the different styles available and tells about their applications. Three pages of capacity charts.



Bulletin 956 features the CASH STANDARD Type 4030 Back Pressure Valve — designed to automatically maintain a constant pressure in the evaporator corresponding to a constant temperature desired. Shows an Ammonia and Freon Gas Capacity Chart based on ABSOLUTE pressures.

1 Air and feed hydrocarbons are raised to reactor pressure in 20 of these 1,000 hp., gas-engine driven compressors.



2 Unit shown at right is one of the reaction furnaces. Here partial oxidation of hydrocarbons occurs.

Petrochemicals

"CHEM. AND MET." ARTICLE ON PAGE 105

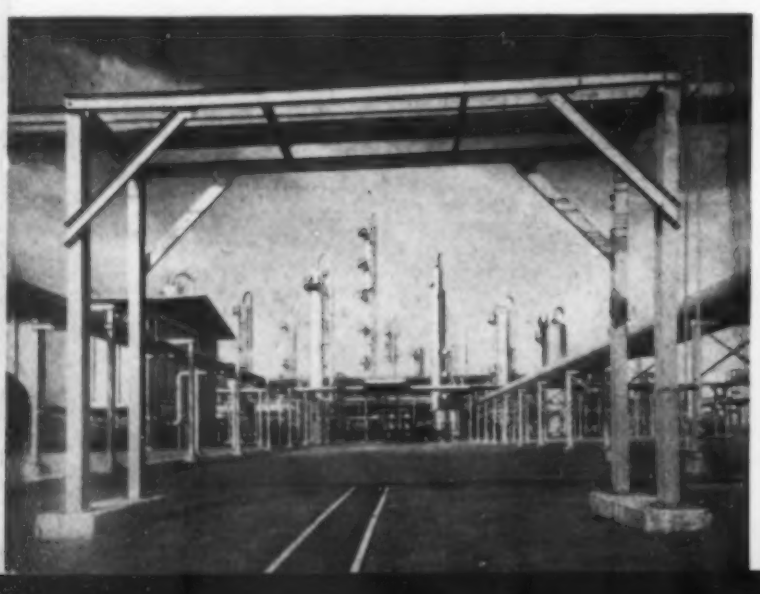
THIS flowsheet outlines the process used by Celanese at Bishop, Tex., for the production of petrochemicals from propane and butane. The hydrocarbons are first compressed and are oxidized by high pressure air. Use of excess hydrocarbons allows control of the partial oxidation. The gaseous products are then cooled, and the valuable chemicals are scrubbed from the gas stream with water. Unreacted hydrocarbons are separated from the remaining nitrogen and are recycled to the oxidation unit. There are four such oxidation units. Next step is separation of the water-chemical mixture into a weak formaldehyde-water stream and a mixture of the various alcohols, ketones, and aldehydes which results from the oxidation. The formaldehyde stream is then concentrated and purified, the end product being commercial 37 percent formaldehyde solution.

The mixed chemical stream from the initial separation flows to two purification units where it is separated into the individual components. In this unit some of the unit operations used include fractional, azeotropic, and extractive distillation, liquid-liquid extraction, evaporation, absorption, hydrogenation, dehydrogenation, and hydrolysis. Products from these units include methanol, acetone, acetaldehyde, isopropanol, n-propanol, and a mixture of butyl alcohols.

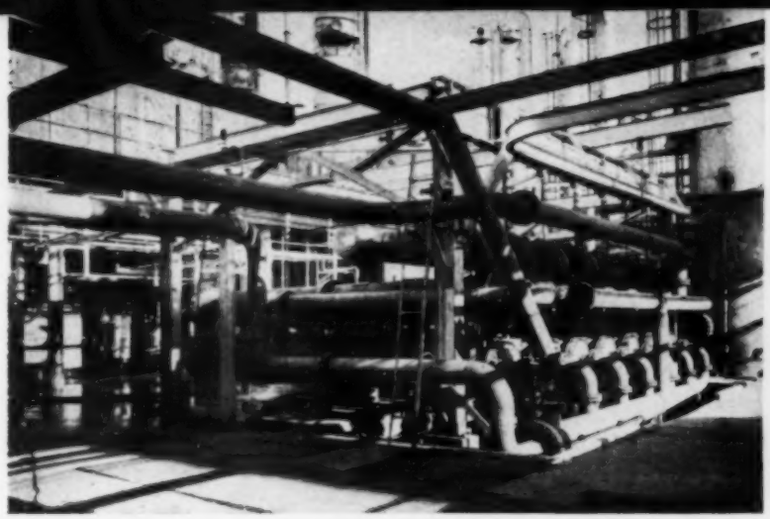
Acetic acid is also manufactured at Bishop. The process consists of oxidation with air of the acetaldehyde produced in the product separation unit. Air and acetaldehyde are reacted in the presence of a catalyst, using an excess of acetalydehyde which is recycled. Product acid is then purified to produce glacial acetic acid.

CHEMICAL ENGINEERING
July 1948
PAGES 136-139

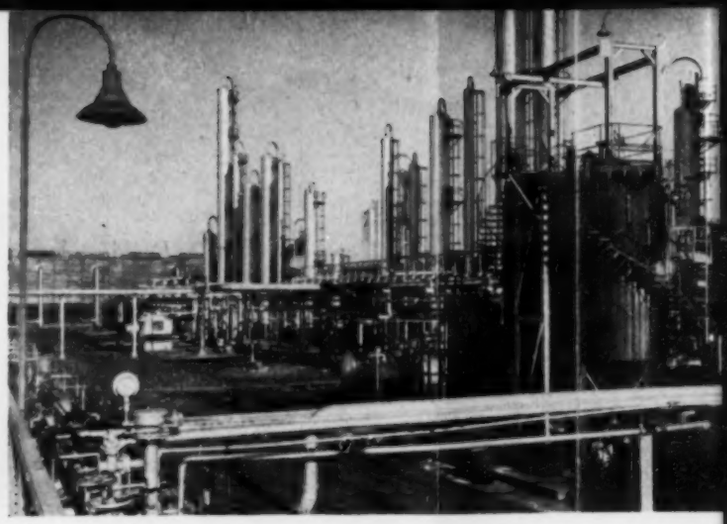
5 Here is the initial separation and purification unit where alcohols, aldehydes, and ketones are separated.



6 A view of the Chemcel tank farm. Storage tanks for in process liquids in foreground, raw materials at rear.

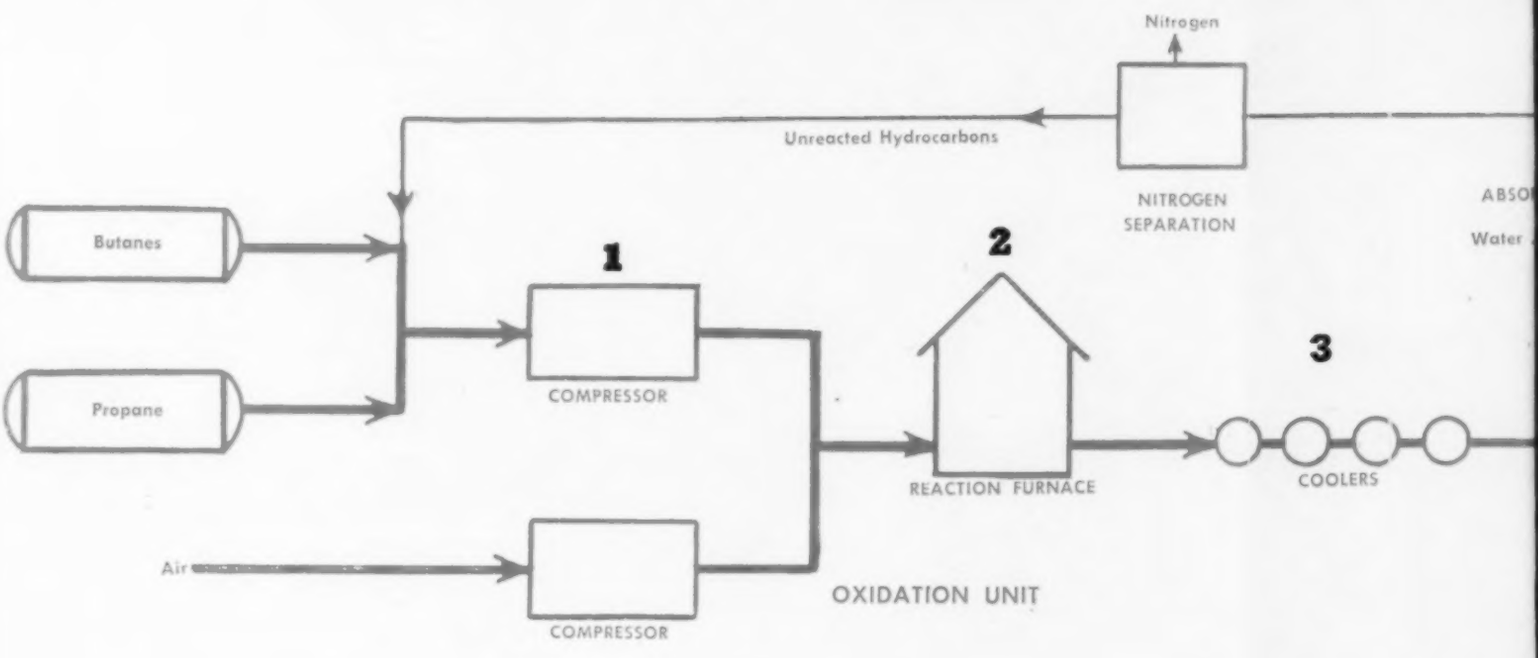


3 These are the shell-and-tube coolers which cool the reaction gas from the oxidation units before absorption of the chemicals in water.



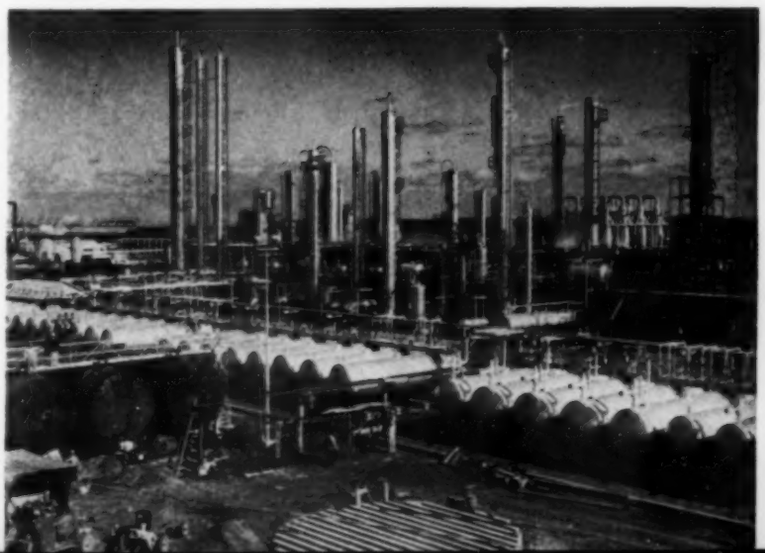
4 This is the acetic acid unit, where acetaldehyde is oxidized with to form crude acetic acid, which is later purified to glacial

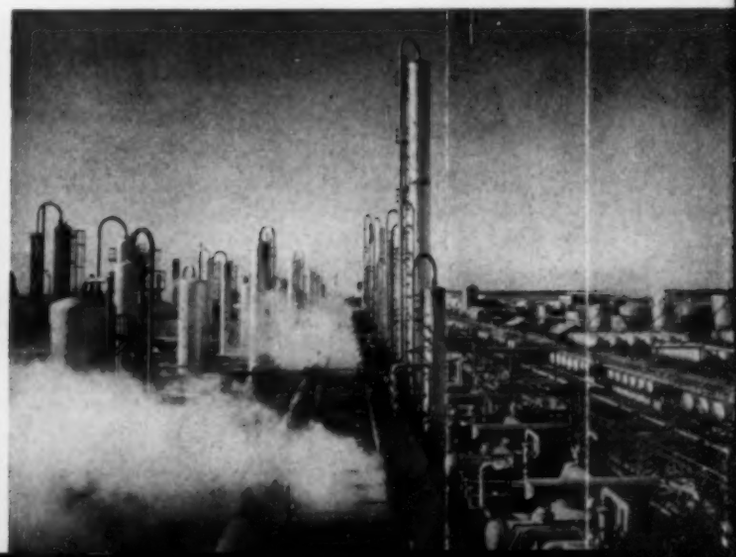
PHOTOGRAPHS BY ELWOOD M. PAYNE



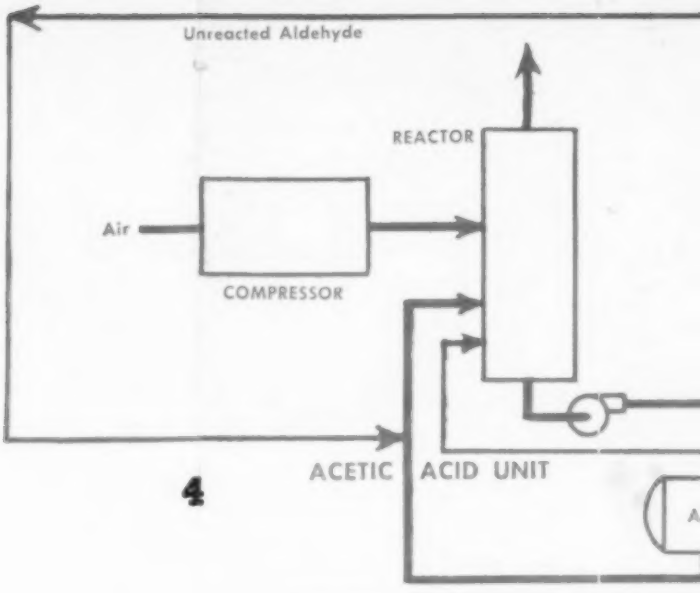
7 Here is the alcohol separation unit. In these towers the primary mixture of alcohols from the initial separation are further separated.

8 The unit in the foreground is the formaldehyde concentration purification plant. At right are process and raw material stora





oxidized with air
l to glacial acid.



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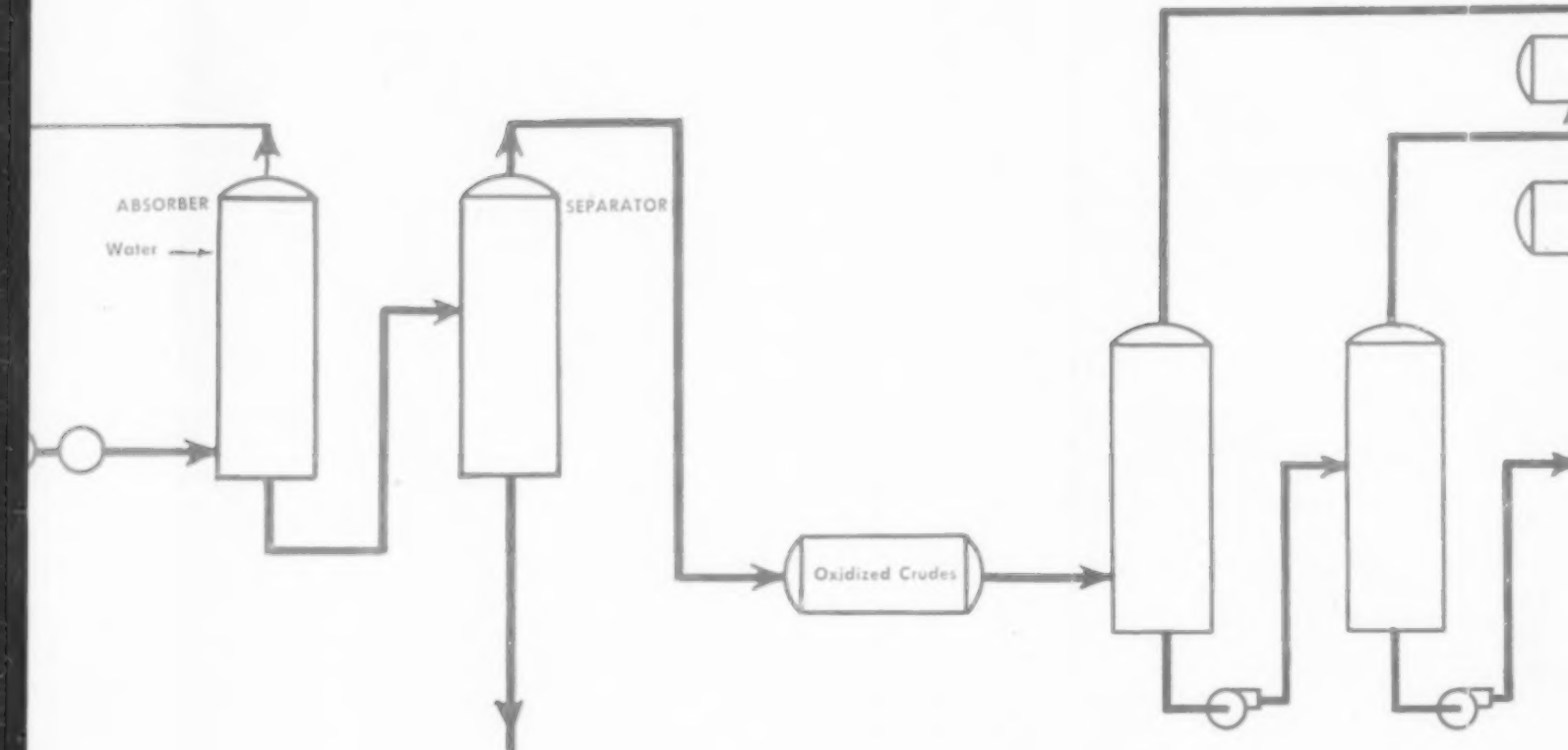
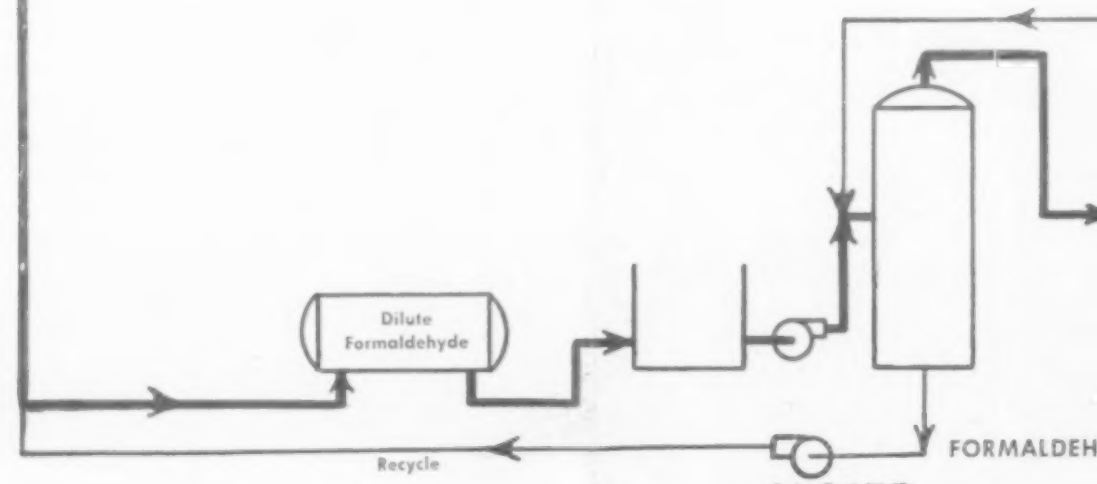


concentration and
material storage.



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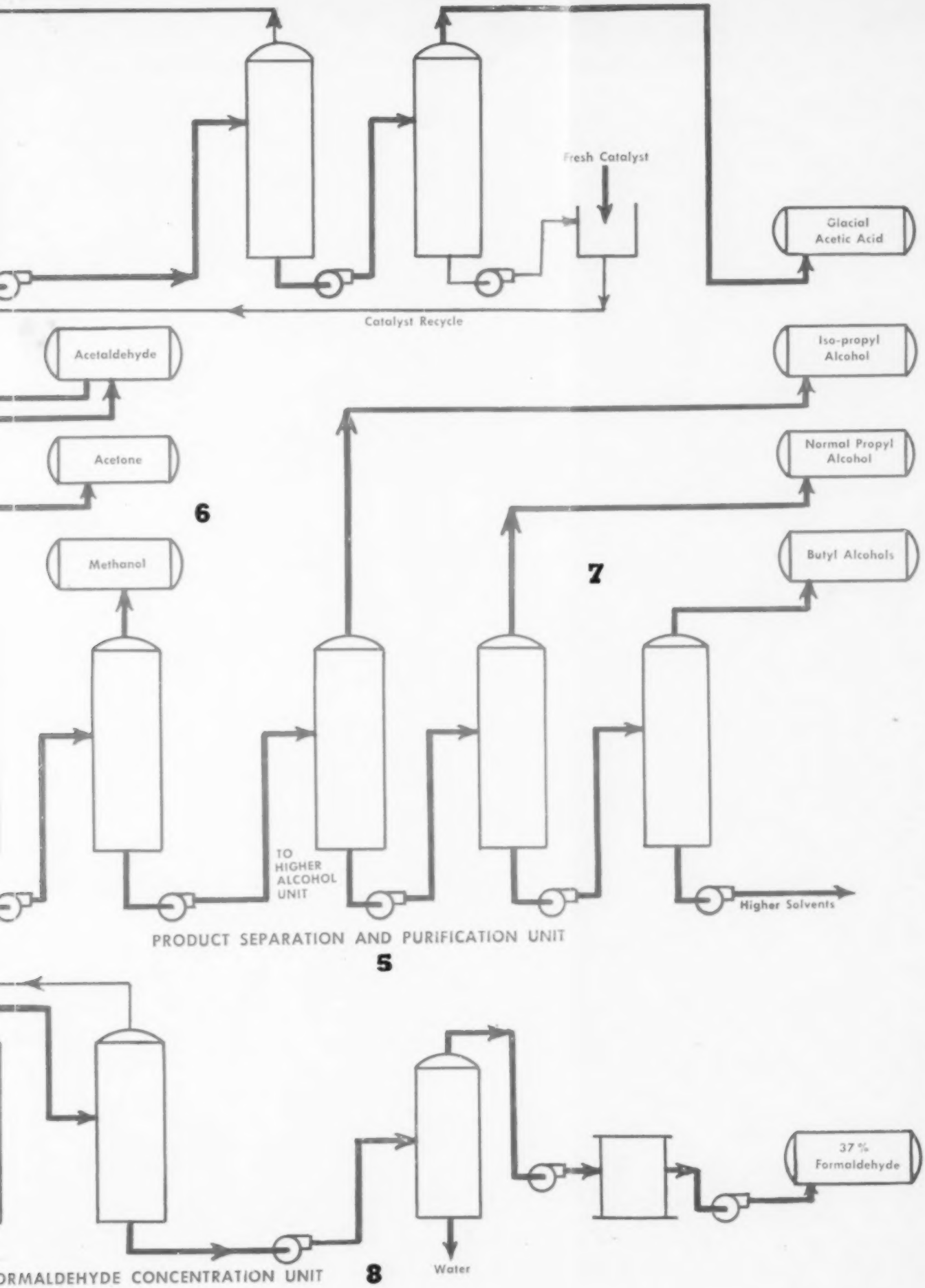
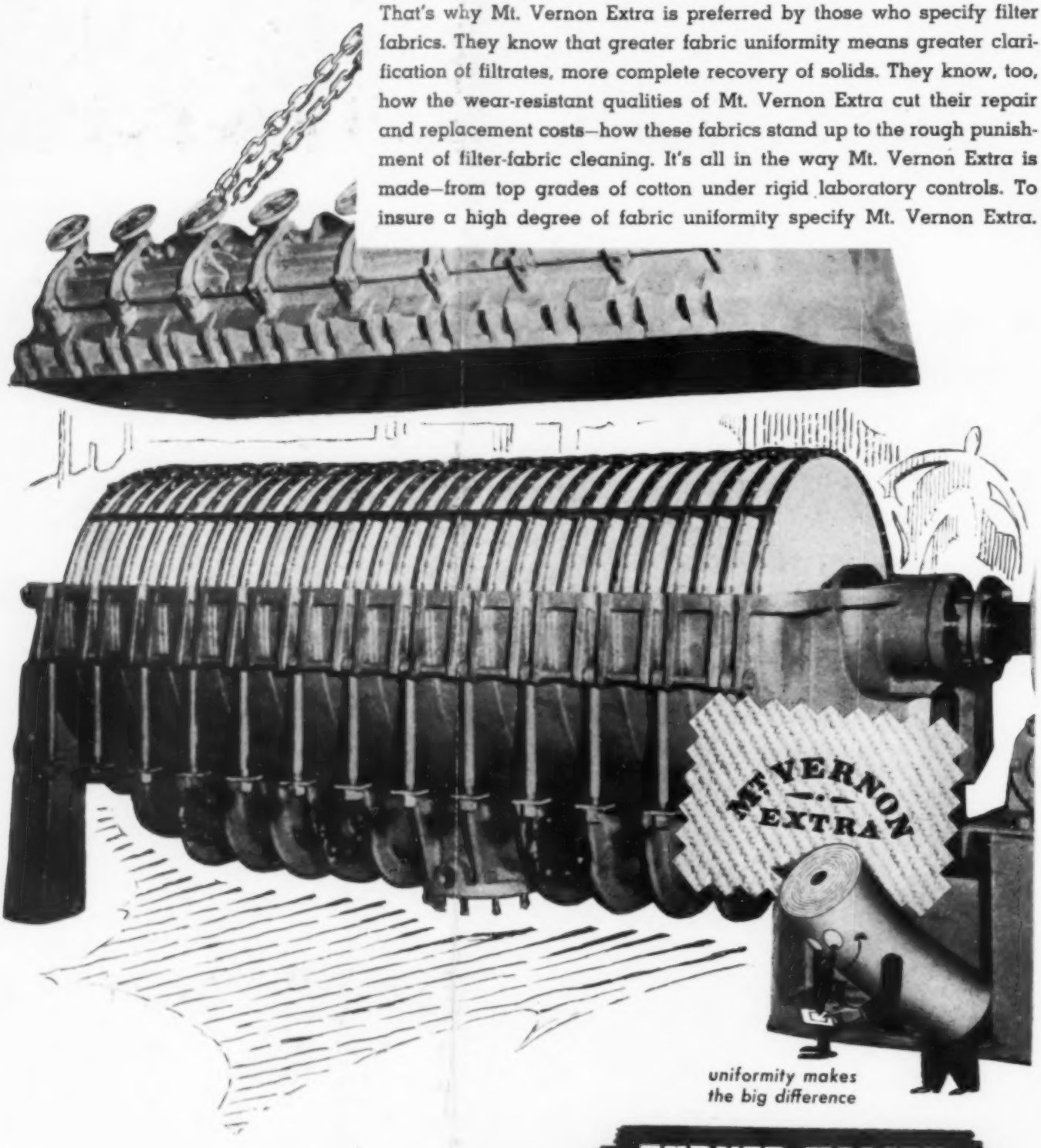

Fresh Catalyst
Glacial Acetic Acid
Catalyst Recycle
Acetaldehyde
Acetone
Iso-propyl Alcohol
Normal Propyl Alcohol
Butyl Alcohols
6
7
Methanol
TO HIGHER ALCOHOL UNIT
Higher Solvents
PRODUCT SEPARATION AND PURIFICATION UNIT
5
37 % Formaldehyde
Water
ORMALDEHYDE CONCENTRATION UNIT
8

Filtering Starts with the Fabric

Filtering efficiency depends to a great degree on fabric uniformity. That's why Mt. Vernon Extra is preferred by those who specify filter fabrics. They know that greater fabric uniformity means greater clarification of filtrates, more complete recovery of solids. They know, too, how the wear-resistant qualities of Mt. Vernon Extra cut their repair and replacement costs—how these fabrics stand up to the rough punishment of filter-fabric cleaning. It's all in the way Mt. Vernon Extra is made—from top grades of cotton under rigid laboratory controls. To insure a high degree of fabric uniformity specify Mt. Vernon Extra.



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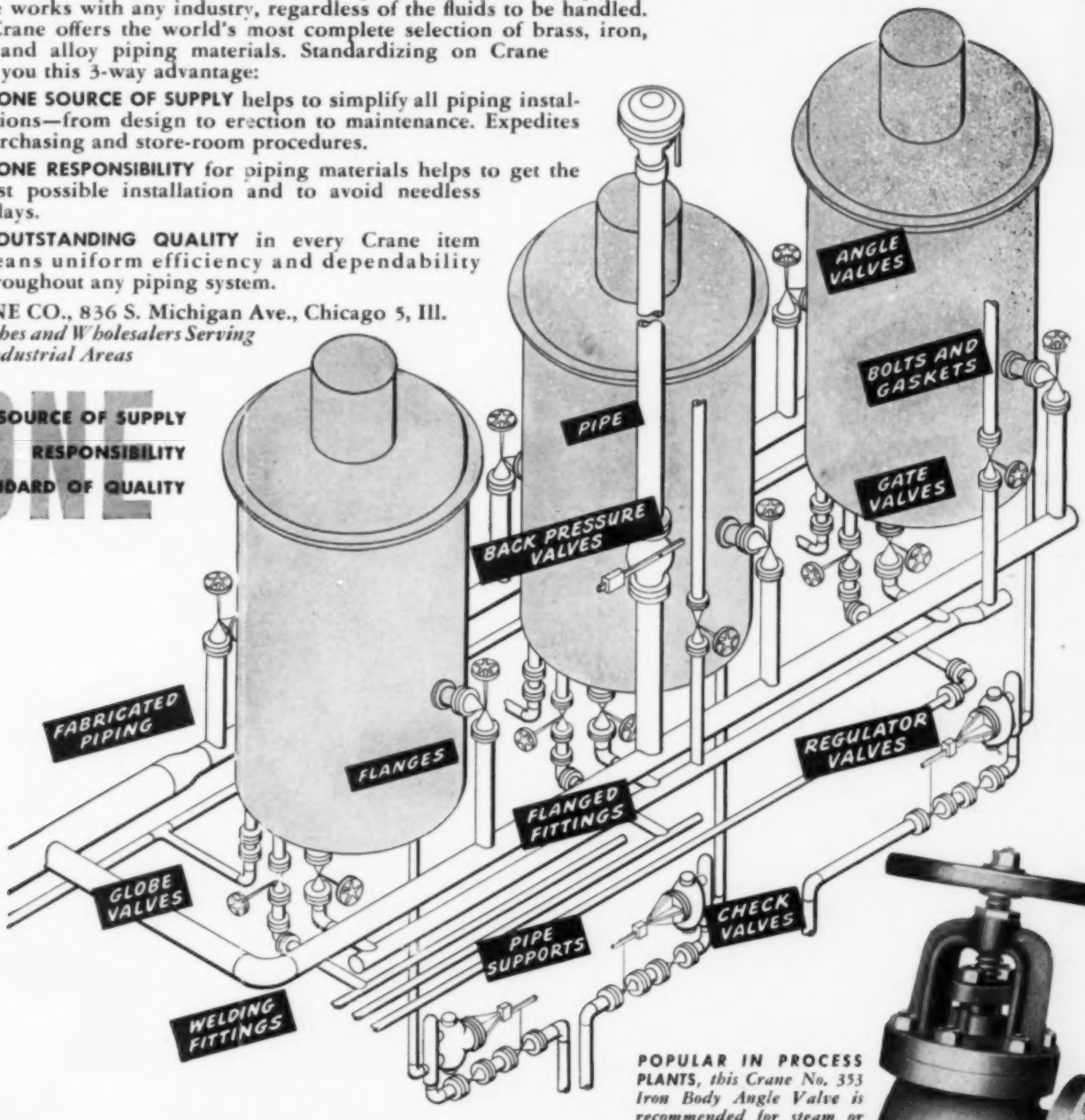

POPULAR IN PROCESS PLANTS, *this Crane No. 353 Iron Body Angle Valve is recommended for steam or water lines, or fluids non-corrosive to brass or iron. Made in all-iron or with brass trim, for steam pressures up to 125 pounds; for cold services up to 200 pounds. Also made in globe pattern. Flanged sizes up to 10 inches; screwed ends up to 8 in. See page 150 in your Crane Catalog.*

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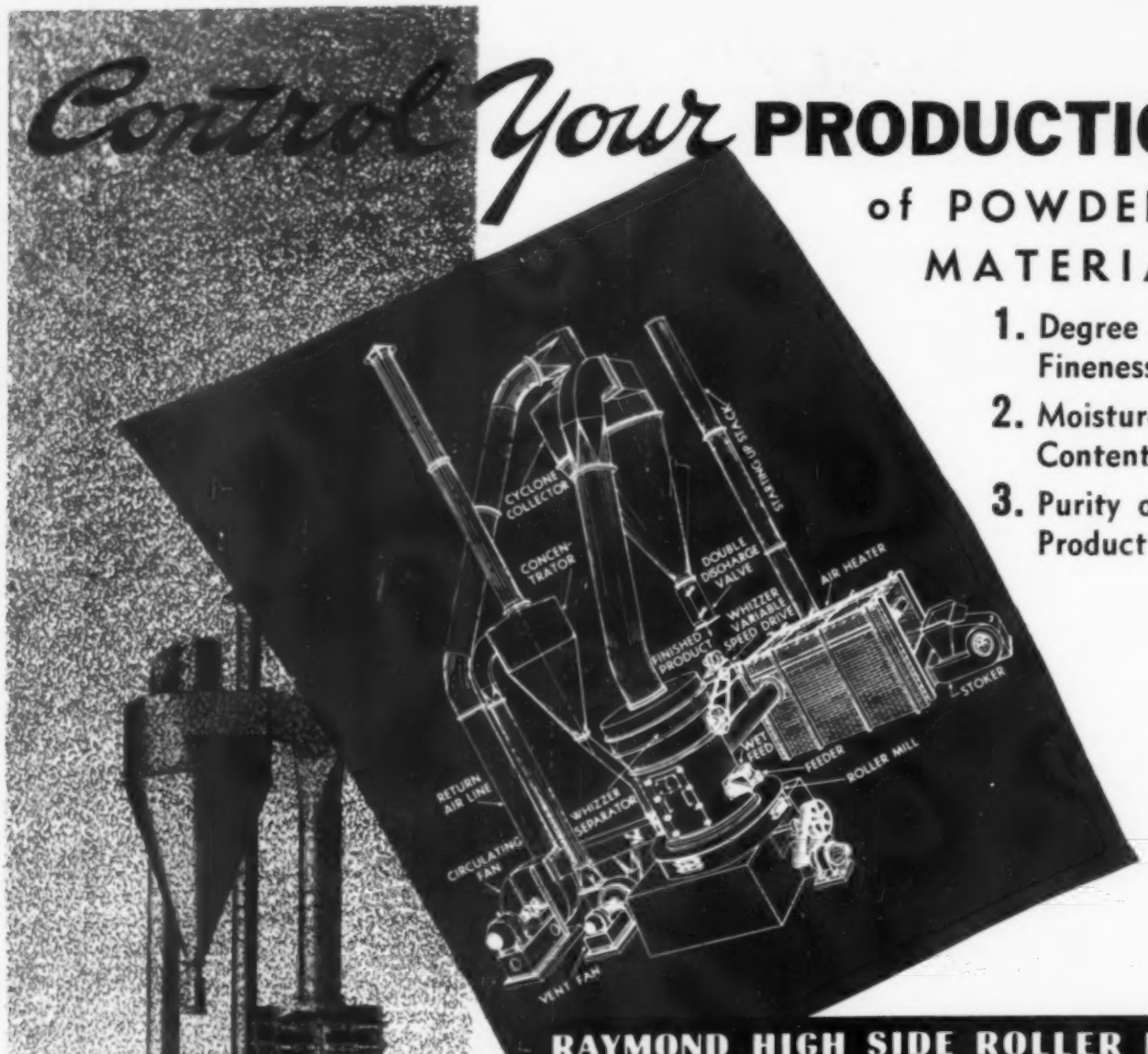

RAYMOND HIGH SIDE ROLLER MILL

with Whizzer Separation and Flash Drying System

THIS combination drying-grinding-separating unit is specially adapted for many uses in the chemical and process industries. It provides an economical method of producing uniform quality powdered materials to meet maximum specifications.

The complete operation is handled automatically and dustlessly. No separate dryers or conveyors are necessary. The entire equipment is compact and flexible in arrangement, and easily installed to fit any plant layout.

Such materials as pigments, clays, gypsum, limestone, fertilizers, synthetic resins, and various chemicals are successfully handled by this efficient method. If surface moisture is present, the product is dried as it is ground, impurities rejected by a throw-out attachment, and the finished material classified to a fine, dry powder.

RAYMOND ROLLER MILL with double whizzer separator gives wide range fineness control simply by changing the speed of the revolving whizzer blades through the variable speed transmission.

Write for Raymond Roller Mill Catalog No. 61.

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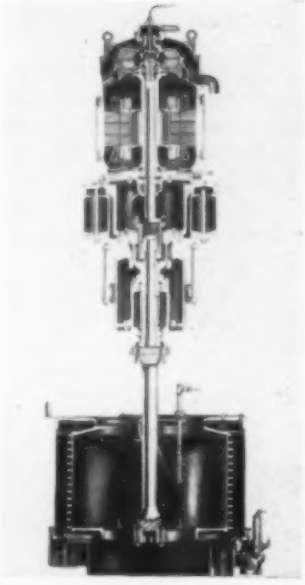
SINCE 1887

PROCESS EQUIPMENT NEWS

Theodore R. Olive, ASSOCIATE EDITOR



CONTENTS

FOR MORE INFORMATION
See Reader Service Coupon on pages 159-160

1. Fluid Drive Centrifugal

To PERMIT a suspended basket-type centrifugal to be accelerated at any desired rate to suit the material being handled, and to permit the top speed of the machine to be selected to suit the material, without limitation to the motor speed, Western States Machine Co., Hamilton, Ohio, has announced a fluid drive centrifugal after several years of successful field use. The centrifugal is being employed in the sugar industry and has recently gone into a variety of other chemical industry applications. In the accompanying illustration it will be noted that the drive motor is surmounted by a fluid coupling. The motor rotor drives a hollow shaft which in turn drives the housing of the fluid coupling. The lower, driven member of the coupling drives a shaft passing through the hollow shaft, which is supported on bearings. This inner shaft drives the suspended centrifugal basket.

Returning to the fluid coupling: The oil for power transmission is introduced into the coupling under pressure in the center of the top housing and is discharged from the coupling through orifices by centrifugal force. It then flows by gravity to an oil cooling tank and then recycles into the coupling. Automatic control of torque and speed are obtained by means of a torque control and speed governor, by varying the amount of oil in the coupling. Thus, the motor runs continuously but the torque exerted, as well as the top speed, is controlled by the amount of oil in the coupling. Thus the centrifugal can be accelerated at any constant predetermined rate to any predetermined top speed, but both factors are readily adjusted to the material being handled. Either speed or torque control may be omitted when unnecessary, in which case the fluid coupling serves only to control acceleration and protect the motor against overload, reducing current peaks by 60 percent as compared with conventional direct-connected motors. The arrangement is said also to help materially in dissipating motor heat.

2. Purge Meter

FOR MEASUREMENT of small flows of gases or liquids in purge systems, the Brooks Rotameter Co., Lansdale, Pa., has introduced the Sho-Rate rotameter which is available in three sizes for working pressures up to 500 psi. These small meters employ a ball float in a tapered tube and have a float travel of 3 in. Flexible arrangements permit the end fittings to be switched in the field to any horizontal connection, or vertical connections may be used. Optional features include a built-in needle control valve, a built-in filter, and an outlet ball check valve. A variety of float materials can be used, giving different capacities.

3. Fog-Foam Nozzle

DESIGNED to provide either foam or fog, a new nozzle first produced to protect aircraft carriers from Japanese suicide bomber attacks, has now been

announced for industrial and fire department use by the Rockwood Sprinkler Co., 38 Harlow St., Worcester 5, Mass. The nozzle, known as the Type FFF, is available for 1½, 2½ and 3½ in. hose and can be used either to apply a wide protective pattern of foam or, with the substitution of a foam shaper for the screen shown in the accompanying view, it can discharge a long-range solid foam stream. By shutting off the foam liquid supply, a high velocity water fog pattern is discharged from the same nozzle.

Foam is provided by equipping the hose line with a special eductor which mixes six parts of special foam liquid with 94 parts of water. The eductor can be installed at any point in the hose line, the mixture of foam liquid and water flowing in liquid form through the hose from the eductor to the nozzle. It does not expand into foam until it leaves the nozzle which means much greater fire extinguishing power for the same hose size than with equipment in which the foam itself passes through the hose.

4. Pallet Retriever

Owing to the present high cost of pallets and the consequent tendency to ship without pallets when possible, the Elwell-Parker Electric Co., Cleveland, Ohio, has developed a pallet-retrieving attachment for standard fork trucks which permits materials to be handled on pallets in the user's own plant but enables the load to be pushed off the pallet into the freight car, with the pallet retained on the fork. The method is particularly applicable in case of shipment to customers who do not have facilities for handling goods on pallets, and therefore cannot benefit from their shipment in this fashion.

The pallet retriever consists of two hydraulically actuated pantagraph-type rams which terminate in a screen frame that remains in a fixed position with respect to the load. The rams are self-adjusting to fit and follow the contour, and vertical or lateral motion, of the load, while the truck with the pallet backs away and withdraws the pallet from beneath the load. The rams can be operated in corners of box cars, since they may be actuated independently or together. The retriever can also be used for pushing loads direct from the fork when pallets are not being used. When there is no need for the retriever, it remains retracted, out of the way, requiring little space and adding little weight to the truck.

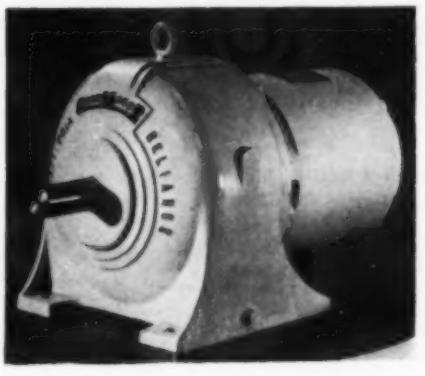
5. Ribbed Conveyor Belt

To prevent back-slip when conveying wet and "soupy" materials up steep inclines, Goodyear Tire & Rubber Co., Akron, Ohio, has developed a ribbed-top conveyor belt of special design. This belt employs chevron-shaped ribs ¼ in. higher than the belt surface, which serve as barriers, trapping the water and preventing back-wash of materials down the belt on inclined operations. The ribs are said to eliminate any noticeable back-slipping of most wet materials on inclines up to 20 deg. At the same time, they are said to increase belt life substantially by reducing the wear a back-slipping load inflicts on a conventional belt in motion. Made in widths of 30 to 48 in., the belt has a five-ply rubberized fabric body and a ¼ in. top cover in addition to the ribs.

6. Hidden Arc Welder

Advantages of the hidden-arc, deep-flux welding process employing high current densities have been extended to manual welding through a new development of the Lincoln Electric Co., Cleveland, Ohio. This is known as the Manual Lincolnweld. The operator of the equipment holds a special aluminum cone-shaped welding gun containing 3½ lb. of flux which is dispensed by gravity through a nozzle in sufficient amount to cover the arc as the weld is made. The gun is attached by a maximum of 25 ft. of cable to a standard 600-amp. welder. The special cable is hollow and the ⅛ in. diameter electrode wire is automatically fed through it at a rate depending on the current being used. The cable also carries the current to the nozzle, at which point the current is introduced to the wire electrode.

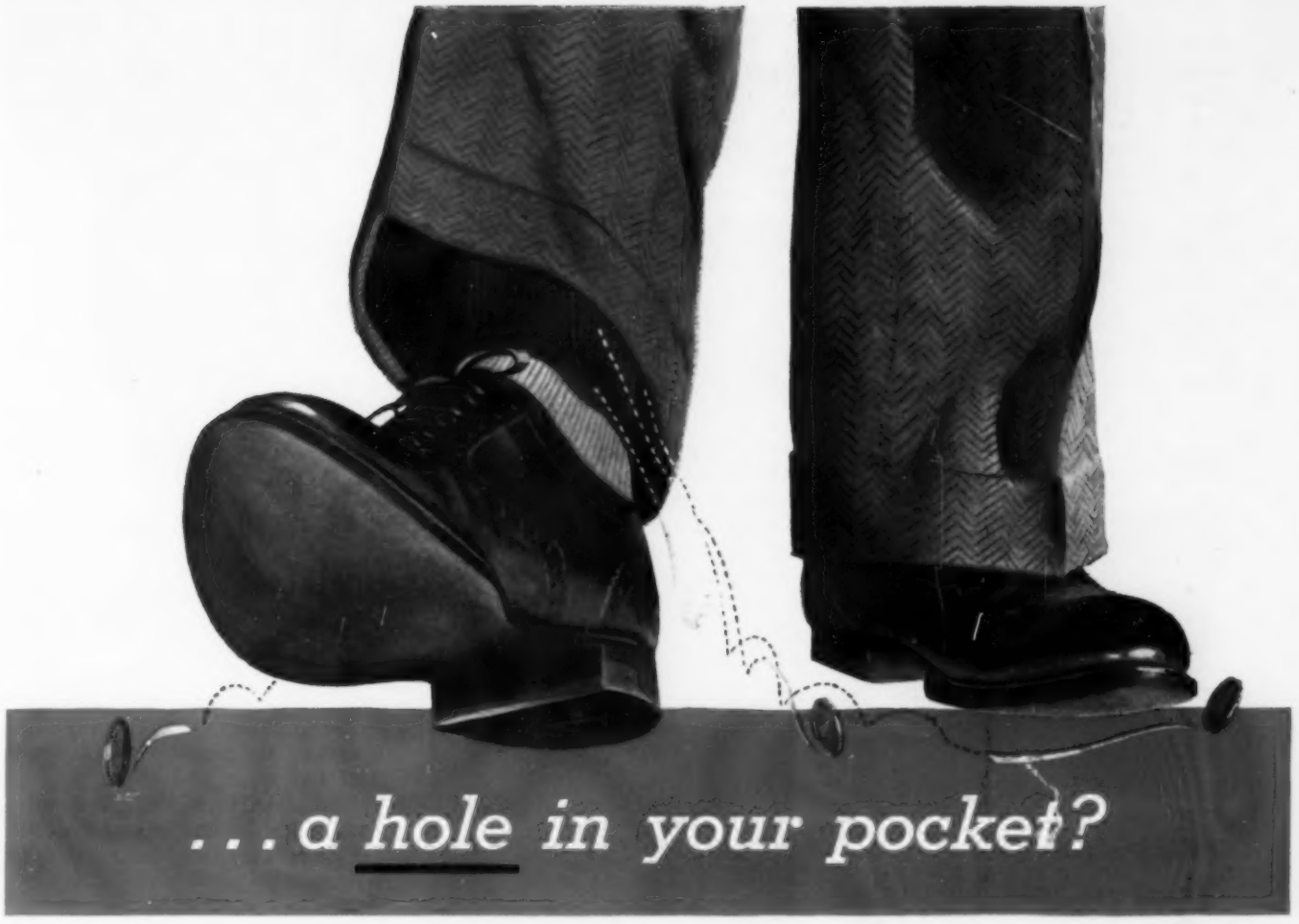
The arc is started by simply touching the electrode to the work through the flux which automatically starts the wire feeding at the proper rate. The wire feed rate is around 300 in. per min., and the current density, said to be the highest ever used, provides sufficient heat to weld ½ in. plate in a plain butt joint, one pass to each side, without edge preparation. The automatic features may be switched off, if desired, for tack welding or finishing short welds.



7. Improved Motors

Two new motors, including an unusually compact gearmotor and a corrosion-resisting motor for chemical service, have been announced by the Reliance Electric & Engineering Co., Cleveland, Ohio. The first of these, the gearmotor, is built in six sizes, from 1 to 60 hp., and employs single, double or triple helical-gear reduction units, giving a speed range from 7½ to 780 rpm. Both a.c. and d.c. motors with flange mounting are available. The design is such that special motor inclosure types can be used without expensive adaptations, including protected open motors, splash-proof, drip-proof, totally inclosed non-ventilated and totally inclosed fan-cooled motors. The gear unit was developed specially for this motor by the Philadelphia Gear Works, Inc., Philadelphia, Pa.

The second motor mentioned, the chemical motor, is being offered in



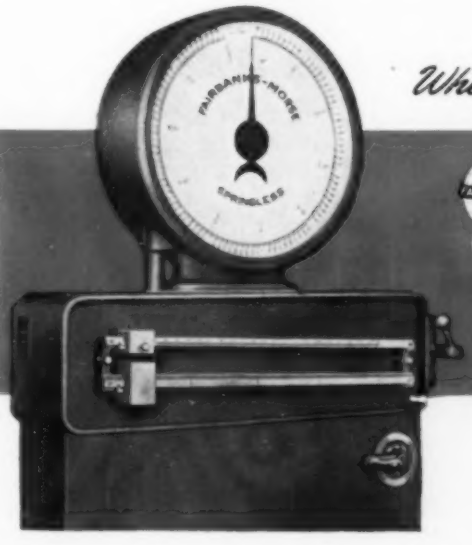
. . . a hole in your pocket?

Or

It is easier to prevent big losses than to prevent cumulative small ones. You are always on guard against the big losses . . . small ones often go unnoticed.

Your scale may be accurate but this is not sufficient insurance that your weights are correct. From many accurate scales in service today it is difficult to obtain a quick, accurate reading. There is still chance for human errors . . . with loss of money and time. When you select a dial scale, you should choose the one which is the quickest and easiest to read. Fairbanks-Morse's unique principle of the direct reading dial in all capacities is a feature found in no other dial scale.

Why not have your local Fairbanks-Morse weighing expert demonstrate the direct reading dial principle and how it can help your operations. He will be glad to do so without any obligation. Fairbanks, Morse & Co., Chicago 5, Illinois.



When it comes to scales...

FAIRBANKS-MORSE

A name worth remembering

DIESEL LOCOMOTIVES • DIESEL ENGINES • STOKERS • SCALES • MOTORS • GENERATORS
PUMPS • RAILROAD MOTOR CARS and STANDPIPES • FARM EQUIPMENT • MAGNETOS

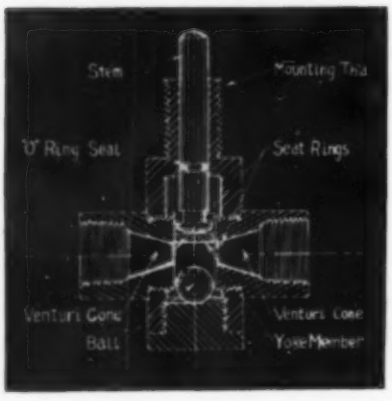
frame sizes from 203 to 326. The motor is built to standards set for Class 1, Group D hazardous locations. The outer cover of the motor is Monel metal, as is the fan cover and lead outlet. The fan is bronze, rather than cast aluminum, and extra grease and bearing protection have been provided by the addition of bronze shaft collars. A variety of other corrosion resistant parts have been employed, depending on the service of the particular part.

8. Rubber Acid Pail

PERFORATED steel with welded seams, covered inside and out with rubber extending through the perforations, is now being used by Automotive Rubber Co., 8601 Epworth Blvd., Detroit, Mich., in the construction of a 5-gal. acid pail. The top of the pail is no larger than that of a 3-gal. pail, in order to decrease the likelihood of liquid splashing or spilling when the pail is carried. The bail and handle are both rubber covered and a pouring lip is provided. The same concern also makes a 3-gal. pail, measures in various capacities, a 2-qt. dipper and a 10-in. funnel.

9. Process Control Timer

A NEW time-schedule controller, designed to be operated jointly with existing air-operated, semi-automatic temperature and pressure controllers in order to make the process fully automatic, is announced by C. J. Tagliabue Corp. (N. J.), 614 Frelinghuysen Ave., Newark 5, N. J. By use of the new instrument it is possible to obtain fully automatic time schedule control at relatively low cost, without disposing of presently installed equipment. In use, the operator begins the process by pressing a starter push-button on the timer, thus lighting a signal lamp. By means of an adjustable cam, timing begins immediately or (if desired) when the temperature has reached the processing point. This temperature is maintained for a pre-determined length of time, and all valves are operated as the process may require, with the elimination of all manual adjustments formerly performed by the operator. When the process is finished, both heating and cooling, the signal light is extinguished.

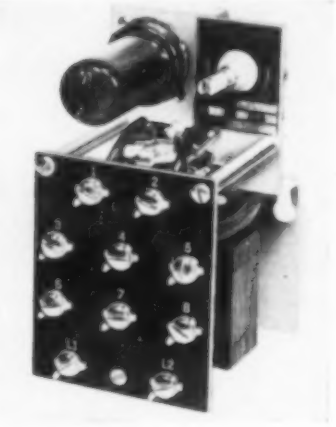


10. Automatic Valve

DEVELOPED particularly for use on automatic machinery where a light actuating force is desirable is a new member of the family of valves introduced by the Paul Valve Corp., 683 Third Ave., New York 17, N. Y. Similar in principle to the hose valve described in our January 1948 issue, the construction of the valve is as indicated in the accompanying sketch. The valve has a venturi cross section in which a metal ball is drawn by venturi action against the outlet port where it seats by fluid pressure. To open the valve, a stem operates a yoke to push the ball down, rolling it out of its seat and into a recess. The shape of the yoke is such that it does not restrict straight-line flow through the valve and it is claimed that the coefficient of discharge is from 95 to 99 percent, with negligible pressure drop. Other types of valves will later be available. The present valve is made in $\frac{1}{2}$ in. nominal size as well as in $\frac{3}{4}$ and 1 in. sizes.

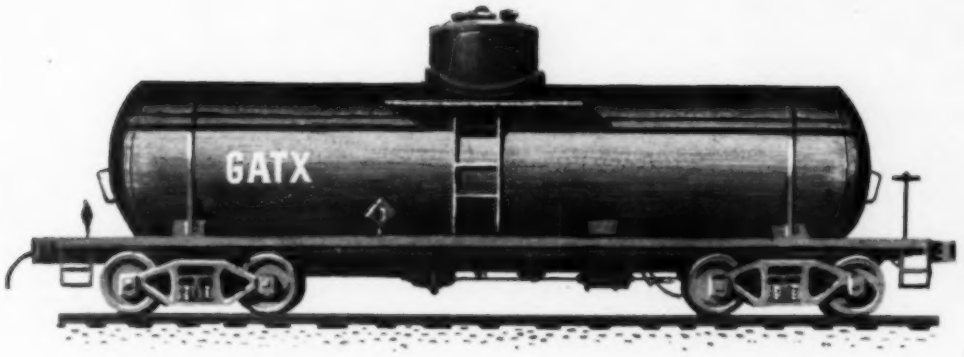
11. Spraying Machine

TO HANDLE up to 6 tons of wet material per hour, Bowen Engineering, Inc., Garwood, N. J., has developed a new high-speed spray machine having a variable speed range up to 20,000 rpm., and power ratings up to 68 hp. These machines are electrically driven, operating on high-frequency current. The feed pipe and atomizing wheel are of stainless steel. The shaft assembly is dynamically balanced, rotating parts being oiled by a gravity feed system.



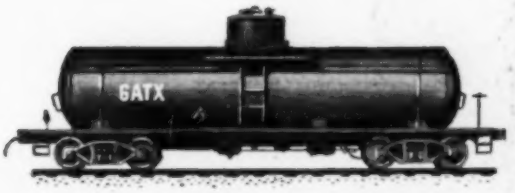
12. Control Relay

IT REQUIRES approximately only 1 billionth of a horsepower of actuating circuit energy to control the action of a new relay for control purposes, known as the Leveltronic, which has been introduced by the R-S Products Corp., Philadelphia, Pa. The relay was designed for use in industrial control problems where pressure, temperature or liquid level are the primary variables. It makes use of a positive acting Thyratron circuit with the tube current limited to less than one-third its maximum value to give long life and low maintenance. Two models cover a range of 20 ohms to above



General American

is filling the gaps in the tank car supply as rapidly as possible



The GATX fleet of more than 38,000 tank cars is growing . . . growing as fast as the still-limited supply of materials permits. When we can get additional materials for building more tank cars, we will use our expanded facilities to furnish *all* our customers with *all* the tank cars they need.

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EXPORT DEPT., 10 East 49th Street, New York 17, New York

FOR MORE INFORMATION
See Reader Service Coupon on pages 159-160

2 megohms, with continuously variable sensitivity giving two-to-one discrimination over the full range. The double-pole, double-throw relay is capable of actuating motors up to ½ hp. It is claimed the unit may employ probe-to-relay distances up to 3 to 5 times longer than other units now on the market.

13. Liquid Level Control

FOR THE maintenance of accurate liquid level control in paper industry stock boxes and header boxes, as well as for other similar applications, the Brooke Engineering Co., 4517 Wayne Ave., Philadelphia 44, Pa., has developed an electrically actuated level control said to maintain level within plus or minus ⅛ in. without hunting or cycling. A modification of this company's standard instrument used in steam pressure and furnace draft regulation, the device is said to give 50 ft.-lb. torque to overcome sticking valves. It is described as low in cost, simple in operation and rugged in construction. A submerged diaphragm is used as the sensitive element to transit pressure by way of a rod to a weigh beam in the level-sensing mechanism. Level indications are converted into electrical impulses to operate a motor in the desired direction so as to control the inlet valve.

14. Pressure Vessel Door

QUICK OPENNING is the feature of a door for pressure or vacuum vessels installed in vertical or horizontal positions that is now being offered by United Welding & Mfg. Co., 8705 Crocker St., Los Angeles 3, Calif. Known as the Harris Quick-opening Safety Door, the design provides a sealing mechanism which is a free-moving, rotating, indexing ring mounted on bearings. No special tools, gears or hand wrenches, and no threaded parts, are required. To open, a breaker bar is inserted in a leverage slot on the indexing ring to turn the ring enough to crack the door and dissipate any remaining pressure. The door, however, is still engaged. One further movement of the indexing ring then permits the door to swing free, the entire operation requiring only about 4 seconds. Closing takes only 2 seconds, since the indexing ring can be turned to a locked position in one movement.

Safety is assured by the fact that at no time during opening or closing is the operator in front of the door. The door is available with a short section of shell, ready to attach to existing vessels, or as part of a complete vessel. It is built for both cylindrical and rectangular vessels.

15. Emergency Light

TO PROVIDE emergency lighting in industrial areas in the event of power outage, Electric Cord Co., 30 Church St., New York 7, N. Y., has introduced a portable, self-contained emergency lighting system provided with two lamps each delivering about 100 watts. Each lamp is capable of illuminating an area of about 10,000 sq. ft. for about 5 hr. Lamp heads are adjustable and may be removed from the unit for installation on walls, stairways, etc. When current interruption occurs the lights are immediately switched on to the battery of the unit. When normal current is resumed the lights automatically go out and a built-in charger restores power to the battery for the next emergency.

16. Rubber-Felt Packing

FELT, in combination with Hycar American-rubber latex and Hycar sheet stock, is now being used by the American Felt Co., Glenville, Conn., to produce mechanical sealing, pack-

How to make your dollars go further in stainless piping

Practical engineers show you the dollar-saving way to increase your alloy piping efficiency in "Corrosion Resistant Piping," a comprehensive discussion prepared by the Taylor Forge engineering staff and on the presses now.

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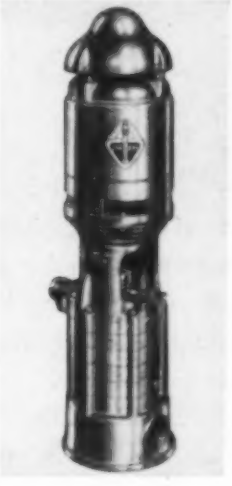
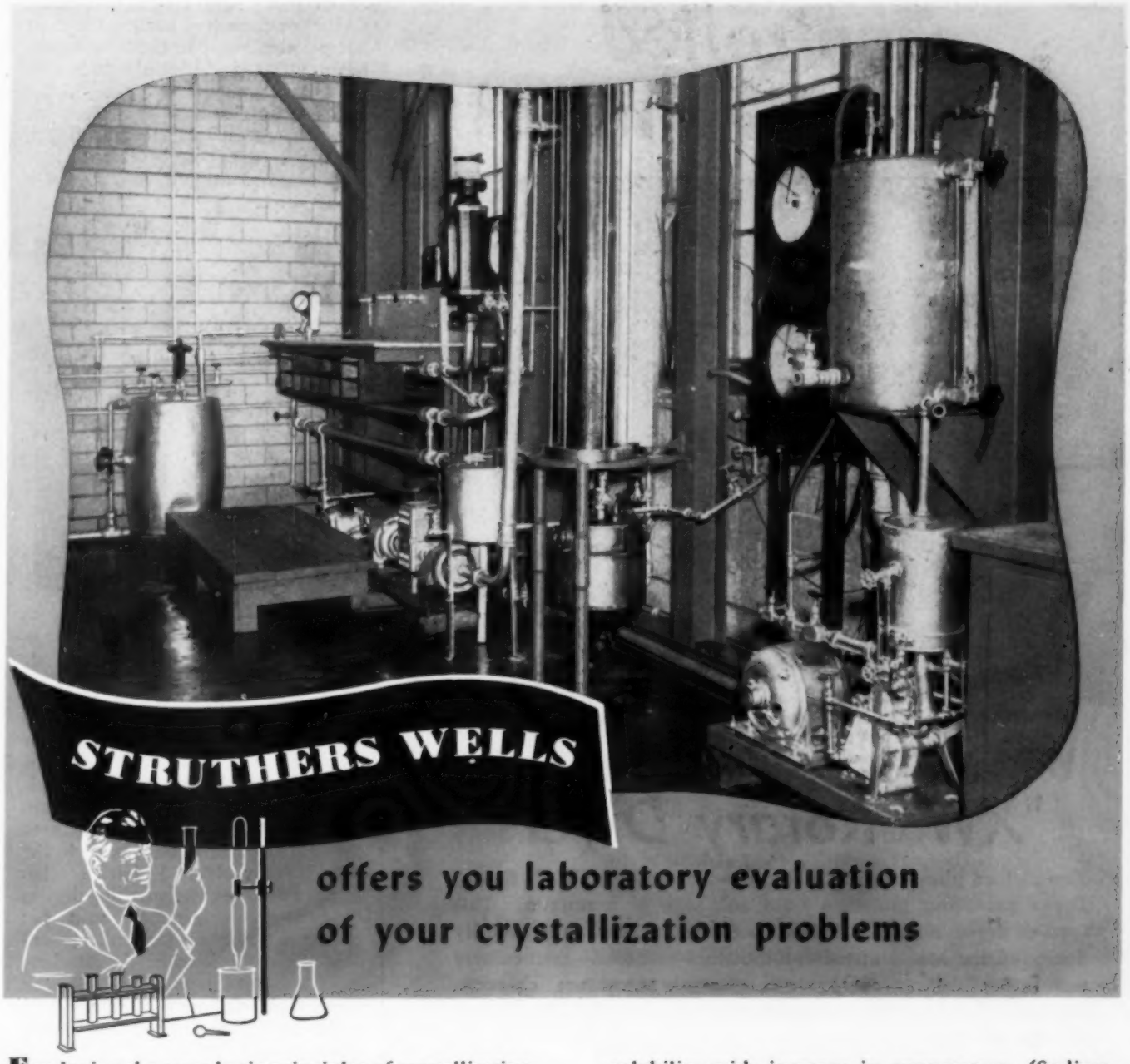
Coupon on pages 159-160

ing and gasketing materials. The combination of these materials is said to enhance the natural properties of both. Cut into strips and washers, the materials are marketed under the names of Vistex and Oil Foil. The first is a Hycar latex-impregnated and laminated felt base packing and sealing material which features a self-lubricating property. The packing is said, nevertheless, to be positively sealed against dirt and moisture. The second material combines a conventional felt seal and one or more impervious septums of $\frac{1}{64}$ in. or $\frac{1}{32}$ in. Hycar sheet. The felt is capable of retaining grease or oil, while the Hycar functions as a positive dam and seal. Many types of Oil Foil washers can retain oil to the extent of more than 400 percent of their own weight.



17. Boiler Feed Pump

SAID TO BE new in boiler feed pumps, is a vertical design of multistage centrifugal pump now being offered by Jacuzzi Bros., Richmond, Calif., and St. Louis, Mo. Designed especially for pumping hot water and for other installations requiring high water pressure, the new pump is produced in two series, one for a maximum of 180 psi. total pressure, and the other for a maximum of 420 psi. total pressure. Standard units are produced in sizes from $\frac{1}{2}$ to 20 hp., while custom-built pumps for special requirements are available. Pumps are designed to operate without lubrication in the pump proper and are provided with heat radiating flanges be-



Employing the same basic principles of crystallization featured in Struthers Wells Krystal crystallizers, our laboratory unit can be utilized to study your problems in crystallization.

The illustration shows the pyrex glass suspension container with salt trap, heater, (or cooler), instrument panel, and vacuum pump. The vaporizer, not shown, is mounted above the suspension container.

The equipment is fabricated of 316 stainless steel and pyrex glass, and can handle a wide variety of corrosive materials.

In addition to the above equipment, a centrifuge is available to illustrate the improved filtration characteristics of Krystal produced crystals.

A few examples of the types of crystallization that can be performed, continuously or batch, in our laboratory are:

1. Crystallization of salts having an inverted solubility. (Anhydrous sodium sulphate, gypsum)
2. Crystallization of salts having a slight increase in solubility with increase in temperature. (Sodium chloride)
3. Crystallization of salts having a substantial increase in solubility with increase in temperature. (Copperas, sodium nitrate)

Whatever your problem in crystallization may be, the Struthers Wells crystallization staff is at your service for consultation or laboratory tests.

Write for our Bulletin #50, describing the principles and applications of Krystal crystallization equipment.

Struthers Wells

Plants at Warren, Pa. and Titusville, Pa.
Offices in Principal Cities

tween pump and motor to prevent undue conduction of heat up the shaft and possible injury to the lower motor bearing. Being vertical, the pumps require a minimum floor space. In the larger pumps several stages are reversed to partially balance end thrust. If desired, this pump can be provided with a steam turbine, rather than a motor drive.

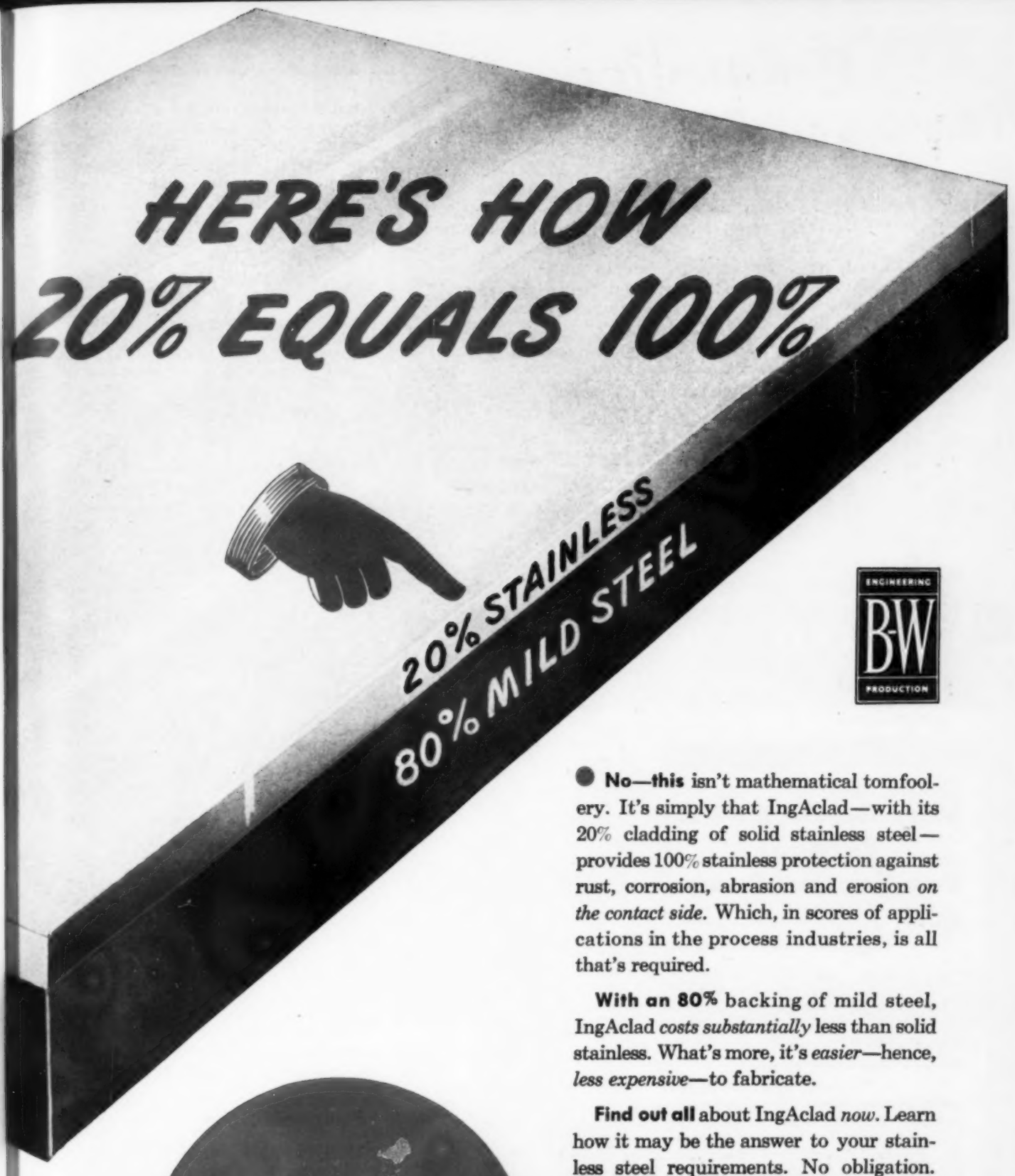
18. Carloading Tube

ACCORDING to an announcement from Dow Chemical Co., Midland, Mich., magnesium tubing 3 in. in diameter is now being used in the construction of spouts and carloading tubes for transferring gasoline into railroad cars. The tube is advantageous because of its light weight and nonsparking characteristics. Owing to the weight (only about ¼ that of other metals used), counterbalancing devices are unnecessary and one man can easily place a tube in a tank car and hold it in one hand while attaching the loading hose coupling with the other. Fabrication costs are also said to be lower as compared with the other suitable metals.

19. Mechanical Drive Turbine

DESIGNATED as Type DP, a small mechanical drive turbine for industrial use is now available from General Electric Co.'s Turbine Division, Schenectady 5, N. Y., in ratings from 10 to 1,200 hp. and speeds from 1,000

HERE'S HOW 20% EQUALS 100%



ENGINEERING B-W PRODUCTION

● **No—this** isn't mathematical tomfoolery. It's simply that IngAclad—with its 20% cladding of solid stainless steel—provides 100% stainless protection against rust, corrosion, abrasion and erosion *on the contact side.* Which, in scores of applications in the process industries, is all that's required.

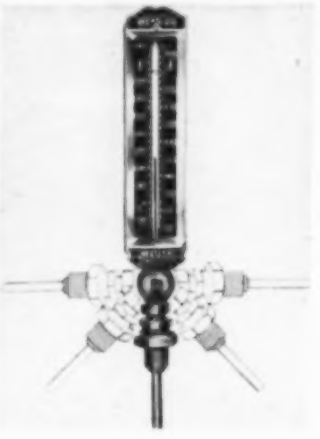
With an 80% backing of mild steel, IngAclad *costs substantially* less than solid stainless. What's more, it's *easier*—hence, *less expensive*—to fabricate.

Find out all about IngAclad *now.* Learn how it may be the answer to your stainless steel requirements. No obligation. INGERSOLL Steel Division, Borg-Warner Corporation, 310 South Michigan Avenue, Chicago 4, Illinois. Plants: Chicago, Illinois; New Castle, Indiana; Kalamazoo, Michigan.

INGACLAD

STAINLESS-CLAD STEEL

to 5,000 rpm. This turbine is produced in three, single-stage sizes with 16, 20 and 25 in. wheels. Like larger turbines, turbines of the new line include hydraulic governors and pressure oiling of bearings. These units have increased accessibility for easier maintenance and most parts are interchangeable on all Type DP frame sizes. This increased standardization permits current deliveries to be made within 15 weeks.



20. Industrial Thermometer

To PERMIT the choice of any angle desired between the stem and the indicating portion of its industrial thermometers, the Weksler Thermometer Corp., 52 West Houston St., New York 12, N. Y., has introduced an "Adjust-Angle" industrial thermometer having a flexible metal capillary within a specially designed ball connection. At any time, and without special tools, the angle between the stem and the case can be adjusted to front or back, left or right, or through 180 deg. of arc. Thus it is not necessary to know exactly what angle will be best when ordering thermometers, a fact which simplifies installation, reduces the number of instruments that must be stocked for plant maintenance, and prevents loss of time in changing from one angle to another.

Equipment Briefs

21. To AVOID the possibility of physical injury to workers in up-ending heavy steel drums, the Melooz Mfg. Co., 4730 Avalon Boulevard, Los Angeles 11, Calif., has introduced an up-ending bar which hooks over the lip of a drum and enables a man to up-end a 300-lb. drum with a force of only 90 lb.

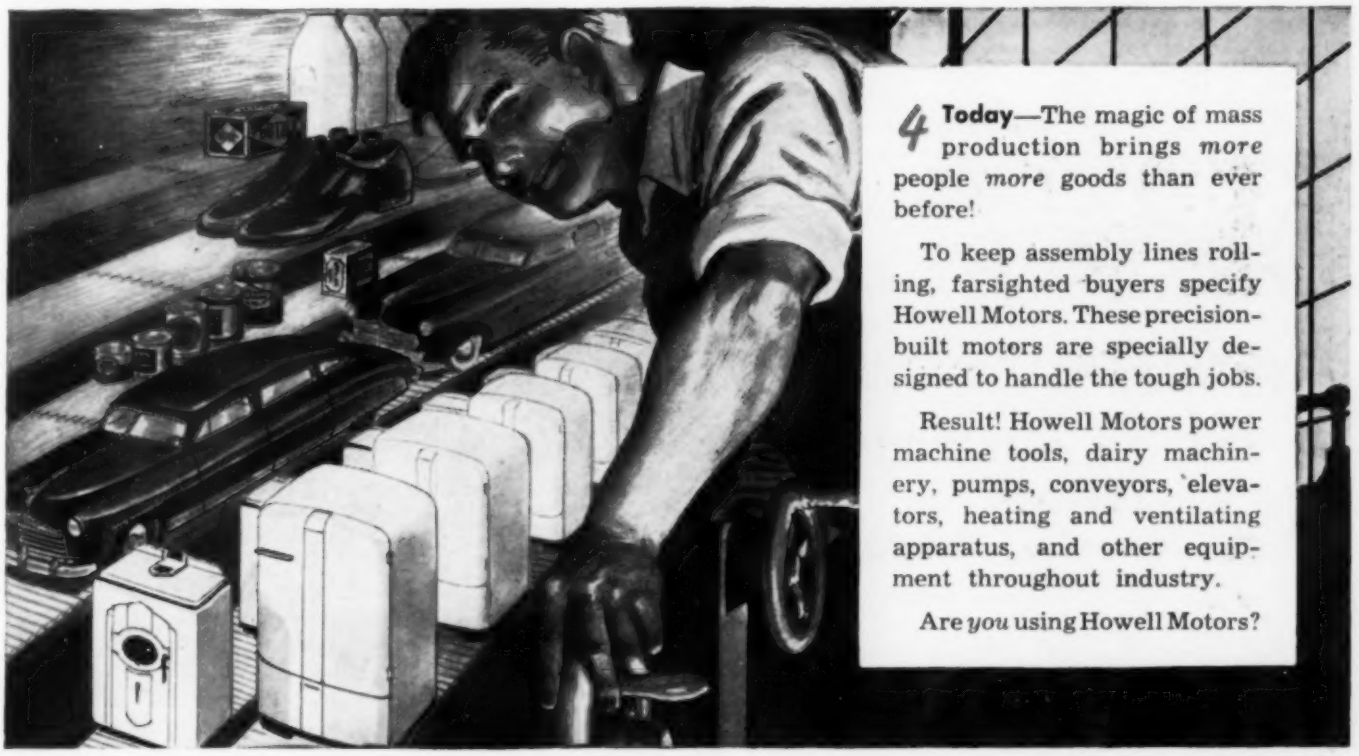
22. WHERE explosive atmospheres are encountered, the Crouse-Hinds Co., Syracuse, N. Y., is offering an explo-

1 1780—Already the newly created Republic felt stirrings of the industrial greatness ahead. A Connecticut hat maker, for example, experimenting with *techniques* of increased production, pushed output to three a day.

2 1876—Mechanical marvels by the thousand at the Philadelphia Centennial dramatically spotlighted America's ability to invent, design, produce. Industrial stage was now set for impact of low-cost electricity, soon to come.

3 1915—Howell "Red Band" Electric Motors appeared! Soon, these rugged, industrial-type motors won recognition in hundreds of vital industries. Assembly lines were on the move! Ford produced its millionth car!

MASS PRODUCTION . . . AMERICA'S MIRACLE!



4 Today—The magic of mass production brings *more* people *more* goods than ever before!

To keep assembly lines rolling, farsighted buyers specify Howell Motors. These precision-built motors are specially designed to handle the tough jobs.

Result! Howell Motors power machine tools, dairy machinery, pumps, conveyors, elevators, heating and ventilating apparatus, and other equipment throughout industry.

Are *you* using Howell Motors?

Free enterprise with mass production raises the standard of living—provides more *goods for* more *people at less cost.*

Here's another precision-built Howell Motor . . . industrial type with copper or bronze bar rotors . . . specially insulated . . . statically and dynamically balanced.

Howell Enclosed, Fan-Cooled Motors—Type K

HOWELL MOTORS

HOWELL ELECTRIC MOTORS CO., HOWELL, MICH.

Manufacturers of Quality Industrial Type Motors Since 1915

FOR MORE INFORMATION
See Reader Service Coupon on pages 159-160

sion-proof electric clock with a 13-in. dial, similar in appearance to the usual electric wall clocks. The clock is constructed to meet Underwriters Laboratories' requirements for atmospheres hazardous because of the presence of flammable gases or vapors, or laden with highly combustible dusts.

23. FORCED convection is employed to assure uniformity of temperature in a new line of electrically heated laboratory ovens offered by Modern Electric Laboratory, 6131 South Wentworth Ave., Chicago, Ill. Made in both floor and bench models, the ovens are available in six standard sizes, and in two series, one series for maximum temperatures of 350 deg. F., the other series for temperatures to 550 deg. F. The multi-blade turbo-blower employed is said to give 50 air changes per minute. The snap-action thermostat is claimed to give temperature control accurate within ½ deg. C.

24. AN ALL-METAL log slide rule for use in industries where the scales must be constantly cleaned, has been introduced by Pickett & Eckel, Inc., 1111 South Freemont Ave., Alhambra, Calif. The rule is non-warping, manufactured to tolerances of 0.001 in., and is said to be unaffected by constant cleaning.

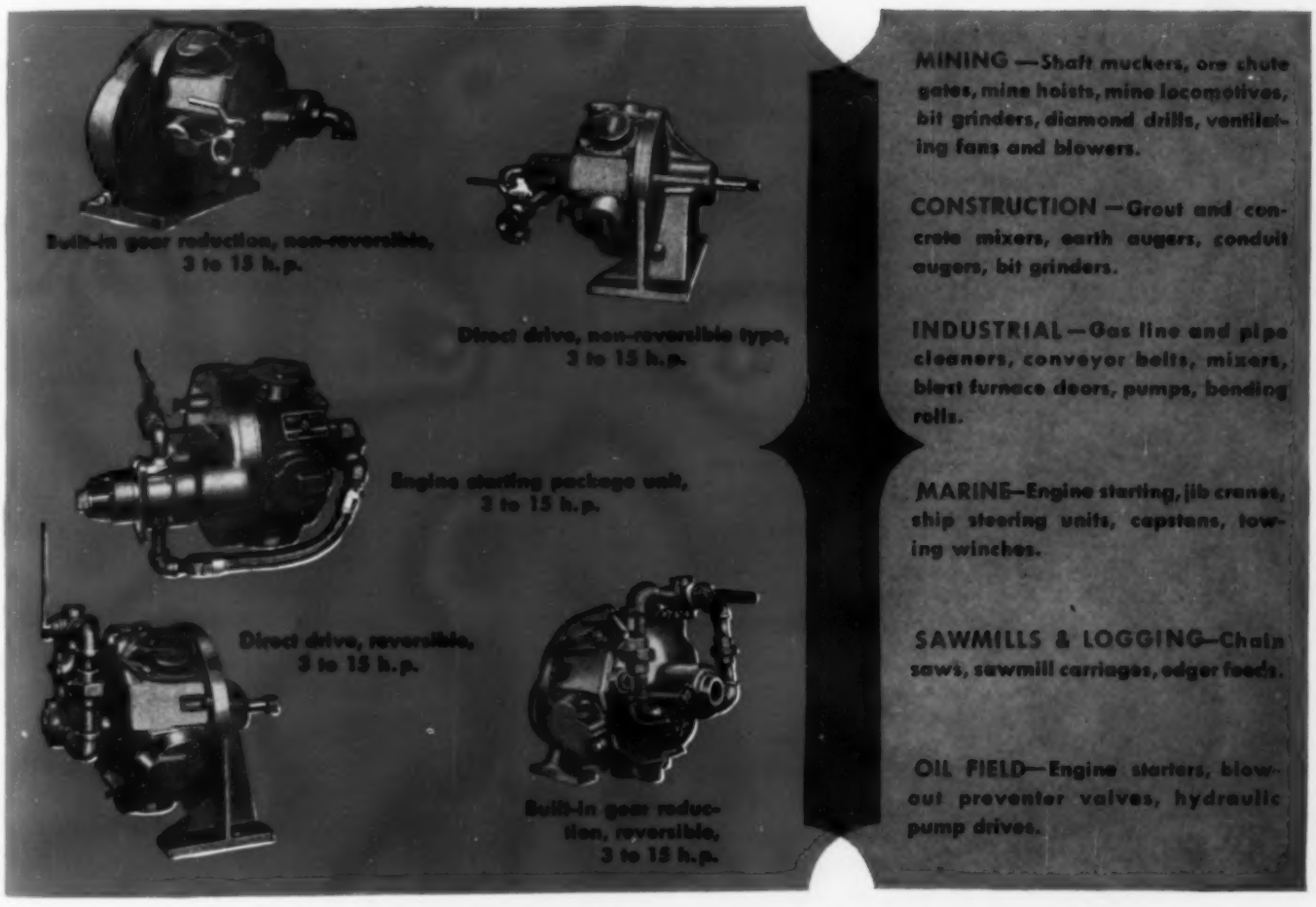
25. A LOW-TEMPERATURE radiation pyrometer suitable for use at the temperatures encountered in rubber and plastic mills, and in continuous curing ovens and paint pigment kilns, is now being offered by the Brown Instrument Co., Wayne and Roberts Aves., Philadelphia, Pa. Control of low temperatures through radiation pyrometry is said to be especially useful where the measuring device cannot come in contact with the materials or processing equipment. The method has formerly been available only for higher temperatures.

26. AS A RESULT of wartime developments, Bauer & Black, 2500 South Dearborn St., Chicago 26, Ill., is now prepared to supply not only industrial adhesive tapes reinforced with Fiberglas, but also a flexible duct connector material of Fiberglas and neoprene. The adhesive used vulcanizes and increases the strength of seal under hot operating conditions.

NO other kind of power excels *air* power in safety, flexibility, freedom from damage due to overloading, and simplicity of control. That's why Gardner-Denver air motors find such a wide application. These 5-cylinder radial air motors are remarkably compact. They can be controlled to operate at any desired speed up to their maximum r. p. m. They have unusually high torque for high starting loads. They are simple, durable and light in weight.

for greater flexibility, safety, convenience . . .

GARDNER-DENVER AIR MOTORS



MINING—Shaft muckers, ore chute gates, mine hoists, mine locomotives, bit grinders, diamond drills, ventilating fans and blowers.

CONSTRUCTION—Grout and concrete mixers, earth augers, conduit augers, bit grinders.

INDUSTRIAL—Gas line and pipe cleaners, conveyor belts, mixers, blast furnace doors, pumps, bending rolls.

MARINE—Engine starting, jib cranes, ship steering units, capstans, towing winches.

SAWMILLS & LOGGING—Chain saws, sawmill carriages, edger feeds.

OIL FIELD—Engine starters, blowout preventer valves, hydraulic pump drives.

For complete information, write Gardner-Denver Company, Quincy, Illinois

GARDNER-DENVER SINCE 1859

If you're interested in valves that will give you any or all of these operating advantages then you'll be interested in

NON-CONTAMINATING

MINIMUM MAINTENANCE

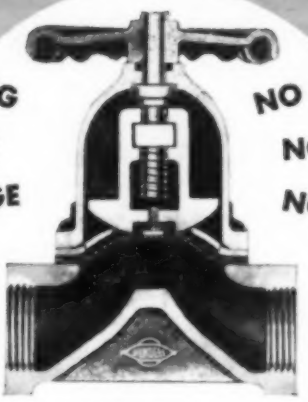
NO VALVE STEM LEAKAGE

NO CORROSION

NO CLOGGING

NO SEEPAGE

GRINNELL - SAUNDERS DIAPHRAGM VALVES

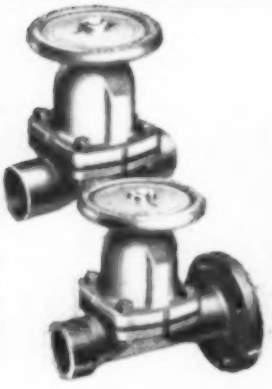


Valve Open

Valve Closed

FOR CHEMICALS

Stainless Steel valves with special diaphragms are handling satisfactorily such corrosive chemicals as phosphoric, acetic and chromic acids.

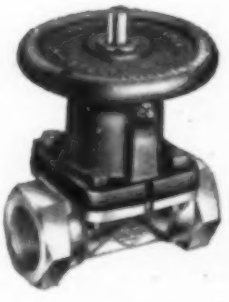


FOR BEVERAGES

Bronze valves with socket ends (left) and with hose threaded end (right), both with special white rubber diaphragms, are stopping leaks and cutting maintenance to the bone in breweries handling millions of barrels of beer.

FOR PULP and PAPER

Rubber lined valves are setting new performance records handling pulp, alum and sulphuric acids in paper mills.

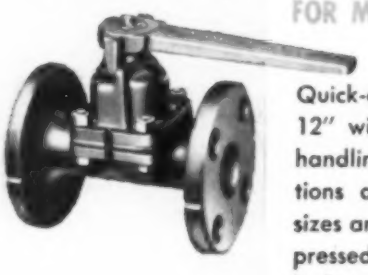


FOR TEXTILE PLANTS

Aluminum body valves with rising stems have won enthusiastic approval in bleacheries handling hydrogen peroxide and other chemicals.

FOR FOODS

Piston-operated valves (left) and air motor operated valves (right), both glass lined and with proper diaphragms, are providing remote control in plants handling sodium chloride, sodium hydroxide, sulphuric acid and fruit juices.



FOR MINES

Quick-operating valves up to 12" with rubber lining are handling highly abrasive solutions and slurries. Smaller sizes are widely used on compressed air lines to prevent leakage.

Grinnell-Saunders Diaphragm Valves may eliminate valve troubles and cut valve maintenance on your pipe lines. Available in any combination of valve bodies and linings, diaphragms and operating mechanisms. State your requirements or ask for Catalog 6-E on "Grinnell-Saunders Diaphragm Valves". Grinnell Company, Inc., Providence 1, R. I. Branch warehouses in principal cities.

GRINNELL

WHENEVER PIPING IS INVOLVED

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PROCESS EQUIPMENT NEWS

See also pages 143-156

NEW PRODUCTS & MATERIALS

See also pages 163-172

MANUFACTURERS' PUBLICATIONS

See also pages 302-306

101. Welding Fittings. Tube Turns Inc., Louisville, Ky.—4-page chart giving valuable information on pipe and fitting materials. Includes (1) ASTM and other specifications, (2) chemical properties, (3) temperature limits, (4) welding data.

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(3) temperature limits, (4) welding data. Provides a quick reference source for the above information on carbon, intermediate alloy, stainless and special analysis steels.

102. Boiler Feed Unit. Roy E. Roth Co., Rock Island, Ill.—6-page bulletin No. 202 describes the boiler feed units, parts and accessories available from this company. Included are detailed specifications and general catalog data.

103. Tank Lining Compound. Union Bay State Chemical Co., Cambridge, Mass.—8-page booklet describing application procedures for the use of this company's tank lining compound for corrosion proofing. Contains two pages of tables of the different chemicals towards which these compounds are chemically resistant.

104. Deionization Equipment. The Dorr Co., New York, N. Y.—28-page bulletin No. 4081 illustrates and describes equipment for the purification of solutions by the ion exchange method. Includes information on theory of operation, operating cycles, treatment costs, and describes various types of units and their main applications. Various types of hookups are schematically illustrated and photographs of the different units and different applications are shown.

105. Power Transmission. T. B. Wood's Sons Co., Chambersburg, Pa.—Bulletin No. 690 contains 24 pages illustrating and describing the "Suregrip" sheaves for V-belts. Contains several pages of dimensions and specifications. Included is a two-page cardboard chart listing the serial numbers, and pitch lengths of this company's V-belts together with the serial numbers of equivalent belts made by other manufacturers. Also contains charts showing possible hub and sheave combination.

106. Chains. American Brake Shoe Co., American Manganese Steel Div., Chicago Heights, Ill.—Bulletin 742-CN contains 28 pages giving comprehensive information on manganese steel and its application in the manufacture of elevating and conveying chains.

107. Chemicals. Edwal Laboratories, Inc., Chicago, Ill.—65-page catalog listing over 50 fine chemicals available from this company. Contains specifications, properties, suggested uses and packing information. Also price list No. 15.

108. Tanks. Black, Sivalls and Bryson, Inc., Kansas City, Mo.—4-page leaflet illustrating and describing the butane-propane skid tanks made by this company.

109. Conveyors. Robins Conveyor Division of Hewitt-Robins, Inc., Passaic, N. J.—16-page booklet No. 127A describes and illustrates the belt conveyors made by this company.

110. Flexible Tubing. Titeflex, Inc., Newark, N. J.—6-page pocket size leaflet describing the Monel flexible tubing made by this company. Corrosion-resisting characteristics for various types of service are outlined.

111. Adhesives. Minnesota Mining & Mfg. Co., St. Paul, Minn.—28-page illustrated brochure giving case histories on the use of 3-M adhesives in industry. Various applications are illustrated such as bonding operations, sealing, and protective coatings for metals.

112. Steel Flasks. Hofman Laboratories, Inc., Newark, N. J.—4-page leaflet illustrating and describing containers and flasks for liquefied gases.

113. Filters. Industrial Filter & Pump Mfg. Co., Chicago, Ill.—Bulletin No. CP-1247 contains 16 pages illustrating and describing filters for the chemical and process industries. Features of construction are illustrated by schematic diagrams. Includes tables of sizes and dimensions and gives information on capacities, specifications, together with a

(Continued on page 302)

These are good for items in this issue only and must be returned by September 30, 1948.

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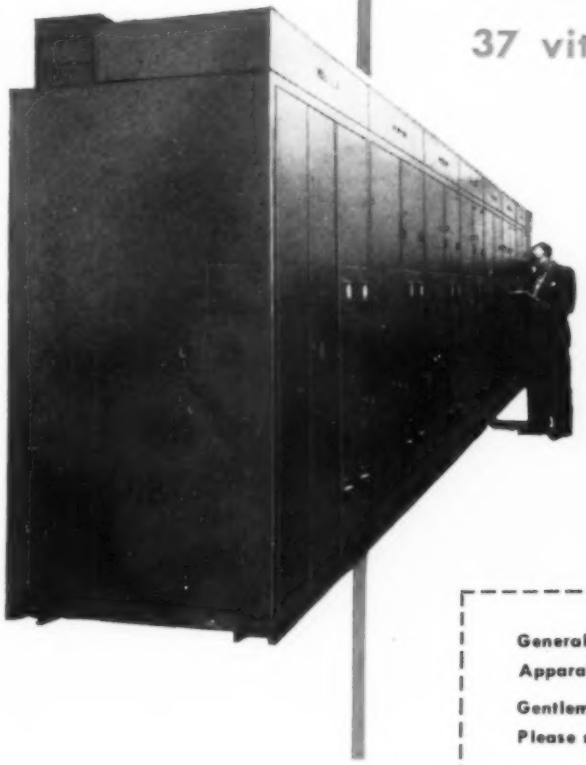
protected...

BY GE LIMITAMP

37 vital operations in this rubber plant



Protection of this plasticator is just one of the vital jobs done by Limitamp starters at the Fisk Tire Plant of the U.S. Rubber Company at Chicopee Falls, Massachusetts. Over a period of four years, more than thirty-seven of these units have been installed in the Fisk Plant to operate generators, mills, Banburys, plasticators—and Fisk plans to add more.

"From a maintenance point of view, I wish we had Limitamp control on all our high-voltage motors." That's what P. L. Butterfield, Chief Electrician at the Fisk Plant says about these controllers.

Decreased maintenance costs are always an important consideration. Users of this equipment have found other advantages: high-interrupting capacity, increased safety, extra-long life, complete motor protection.

You'll need more information about these starters. Fill in the coupon and mail it to us. *Apparatus Department, General Electric Company, Schenectady, N. Y.*

General Electric Company, Sect. C676-259
Apparatus Department, Schenectady 5, N. Y.

Gentlemen:

Please send me your publication GEA-4247 on the G-E Limitamp controller.

Name_____

Address_____

GENERAL ELECTRIC

NEW PRODUCTS AND MATERIALS

Richard W. Porter, ASSISTANT EDITOR

CONTENTS

51. Ion Exchanger

Now available from the Resinous Products & Chemical Co., Philadelphia 5, Pa., is a new high-capacity synthetic resin cation exchanger in bead form. Its trade name is Amberlite IR-105, and it is claimed to widen the usefulness of the family of Amberlite ion exchange resins.

Key advantages of the new cation exchange resin are claimed to be: (1) a smooth spherical shape, (2) freedom from odor, taste and color-throw, (3) uniform particle size, (4) high density, (5) rugged physical properties, and (6) high exchange capacity obtained at efficient regeneration levels. Its good chemical stability and high capacity are of special interest in applications such as the softening, dealkalization, and deionization of water.

The resin derives its activity from sulphonic acid groups, and may be employed either in the sodium or hydrogen cycle. It is shipped in the sodium form (in a moist, completely swollen condition) but can easily be converted to the hydrogen derivative by treatment with mineral acids. Specific physical characteristics of Amberlite IR-105 are: a density of about 47 lb. as shipped (corresponding to 1 cu. ft. of space in place backwashed and drained); a moisture content of 40 to 50 percent; a wet screen grading of 16 to 50 mesh; an effective particle size of 0.4 to 0.6 mm; a maximum uniformity coefficient of 1.7; and voids of approximately 45 percent. High physical stability insures against attrition losses. Chemically it is insoluble in all common solvents including water, aromatic and aliphatic hydrocarbons, etc. Best results are obtained from operating in a solution free from turbidity at a pH of less than 8.5, and temperature not exceeding 120 deg. F.

52. Metal Cleaners

SINGLY or in combination, Calgon Metal Cleaner No. 21 and Calgon Emulsion Cleaner may be used for cleaning a wide variety of metals and alloys. Calgon, Inc., Pittsburgh, reports that the combination of the cleaners gives the advantages of an alkaline cleaner as well as an organic solvent when used for immersion cleaning or especially difficult spray-cleaning. They are said to be effective for saponification of fats, deflocculation or dispersion of dirt and emulsification of oils and greases.

FOR MORE INFORMATION
See Reader Service
Coupon on pages 159-160

Calgon Metal Cleaner No. 21, a dry granular alkaline detergent, is designed for spray-cleaning in metal-washing machines. It prevents the build-up of lime scale or other deposits on pipelines, pumps, heating coils, nozzles and tanks as a result of water hardness. Glassy sodium phosphate in the cleaner ties up calcium and magnesium salts in the water so that they cannot form deposits. Although designed for cleaning of steel products or parts, it is said to effectively spray-clean aluminum without etching its surface. In long immersion or dip-type cleaning of aluminum, slight etching may occur. The manufacturer states that it is an excellent pre-cleaner when the metal surface is to be phosphate-coated or otherwise treated.

Calgon Emulsion Cleaner is a white, creamy emulsion of an organic solvent in a small amount of water. It disperses when added to the cleaning bath. Either alone or in combination with an alkaline cleaner, it is said that hot or cold water will rinse it off a metal surface leaving no solvent or other film. Neutral and non-corrosive, the emulsion has no known harmful physiological effect; Calgon Metal Cleaner No. 21 is also harmless.

53. Plastic Coating

NOW PRODUCED in quantity by the United States Rubber Co., Rockefeller Center, New York, N. Y., is a new type of decorative material. The material is an outgrowth of war production, combining fabrics and plastics, which was widely used in war planes. Since the war, a commercial modification of it has been manufactured for a broad range of civilian uses. Among the important uses foreseen, as a result of these installations, are wall covering in rooms and corridors, furniture surfacing, and tops for tables, counters and desks.

Known as Satusply, the material is now being produced in 34 different colors and patterns, with gloss or satin finish. A cigarette-proof type is available in all colors, designs and finishes. It is made in continuous rolls and in several widths and thicknesses. Standard length of rolls of the cigarette-proof type is 60 lineal ft. and of the non-cigarette-proof type is 90 ft.

In producing Satusply, paper or cloth is completely impregnated and surfaced with a polyester thermosetting resin, then processed under heat and tension. Color and design possibilities are almost unlimited, since a variety of papers or cloths in plain colors, or in designs, can be used as a base. Degree of stiffness can be readily controlled. The protective coating formed by the resin makes the nonporous plastic material washable, highly resistant to stains, acids, alka-

lis and wear. A special cement, called Satusply-Sement is available to bond the material satisfactorily to the base surface. For some uses, it is pre-applied to the back of the sheets at the factory, ready for installation in the field. It is also furnished in containers for application on the job.

54. Duplicating Fluid

Designed to give a high degree of brightness and clarity as well as good coverage per gal. to spirit duplicating machines, EP Duplicating Fluid is being produced by the Schwartz Chemical Co., Inc., 328 West 70 St., New York 23, N. Y. Tested by ASTM methods, the manufacturer found it to be non-corrosive to the metal parts of the machines and non-injurious to rubber rolls. It is said to be quick-drying, non-curling and practically odorless. It is available in 1-gal. cans or 54-gal. drums.

55. Methacrylic Acid

Supplied as a 40 percent aqueous solution by Rohm & Haas Co., West Washington Square, Philadelphia, Pa., monomeric methacrylic acid is now available in commercial quantities. Purity of the acid is better than 96 percent and the polymer content is less than 0.1 percent. Fractional distillation yields a concentrated aqueous solution of methacrylic acid. The anhydrous acid can be prepared by solvent extraction of the aqueous solution. Methacrylic acid polymerizes readily to give, under most conditions, a water-soluble polymer. Copolymerization with other monomers gives alkali-soluble polymers. Small amounts of free acid groups in polymers are reported to improve adhesion of the polymers in some instances when used as coating.

In addition to its use as a monomer, the reaction double bond and free carboxyl group of methacrylic acid may be utilized in chemical synthesis. Substituted isobutyric acids can be prepared by addition to the double bond, or special methacrylic esters can be made by esterification, where the preferred preparation by transesterfication of methyl methacrylate or directly from acetone cyanohydrin is less attractive. Preparations of methacrylic chloride and methacrylic anhydride are also possible from the acid.

56. Cation Exchanger

Recently developed by Chemical Process Co., Redwood City, Calif., is a weak acid-type-cation exchanger with the trade name of Duolite Cation Se-

CHLORINATED AROMATICS

Important to many processes as intermediates and solvents in the production of Pharmaceuticals, Dyes, Fungicides and Organic Chemicals.

CH_2Cl	$COCl$	CCl_3
BENZYL CHLORIDE	**BENZOYL CHLORIDE**	**BENZO-TRICHLORIDE**
Chlorinated Benzaldehydes	Chlorinated Benzotrichlorides	Chlorinated Benzyl Chlorides
Chlorinated Toluenes	Chlorinated Benzoyl Chlorides	Chlorinated Benzoic Acids

Ortho and Para chloro, 2,4 and 3,4 Dichloro, as well as several higher chlorinated derivatives, are also available.

Technical literature covering properties, specifications and shipping details will be mailed promptly on request.

PUT THE PLUS IN YOUR PROCESS

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FINE HEYDEN CHEMICALS

lector CS-100. In the presence of a buffering anion which prevents the pH from dropping, this material will selectively and completely remove divalent ions over monovalent ions. Even where a pH drop occurs, the divalent ions are removed selectively; however, some leakage does occur, depending upon the extent of the drop.

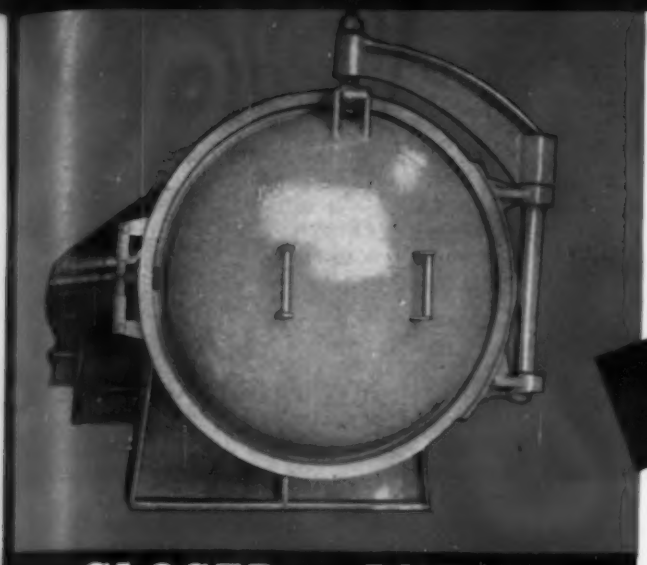
One indicated use of this material is its employment to remove calcium salts ahead of a standard deionization unit. This eliminates to a certain extent the calcium load upon the sulphonic acid-type cation exchanger. The latter experiences difficulty, when sulphuric acid regenerant is being used, in handling a heavy calcium load because of low acid efficiency and a calcium sulphate blockage. Used ahead of the deionization unit, the new selector can be regenerated with waste acid from the latter. The material also shows promise in the fractionating of cations and perhaps amino acids.

57. Hydrocarbon Solvents

THREE new commercially pure hydrocarbon solvents have been made available for bulk shipment by Esso Standard Oil Co., 15 West 51st St., New York 20, N. Y. Known as Esso Hexane, Esso Heptane and Esso Octane, they should find use in protective coatings, rubber and vegetable oil extractions. It is said that these close-cut hydrocarbons give greater control in coating formulations, uniform evaporation rate from start to finish, improvement in odor, freedom from residual odor, less solvent retention by most resins and greater flexibility for blending.

58. Styrene Copolymer

A NEW low cost high styrene copolymer resin called Darex Copolymer X43 was recently announced by the Dewey and Almy Chemical Co., Cambridge, Mass. Now in large scale production, this new rubber chemical was especially developed for stiffening GR-S synthetic rubber in the manufacture of high grade shoe soles. It has proved satisfactory in factory trials, and is claimed to be valuable in wire insulation, extruded goods, fabrics and



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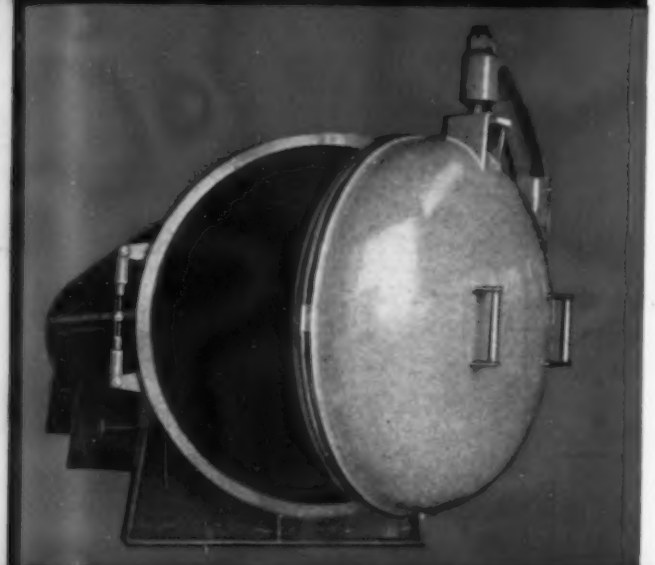

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THIS DOOR

FOR HORIZONTAL VULCANIZERS AND CURING CHAMBERS, IS

QUICK

TIGHT

BOLTLESS

Blaw-Knox now offers this Quick Opening Door for vulcanizing and curing chambers, using working pressures up to 250 p.s.i., in diameters up to 10 ft. This door is *boltless* with an expanding rim-locking device, and is made tight by a pressure-actuated gasket.

Applications include: rubber vulcanizers; steam curing of concrete blocks; curing of safety glass and plastics; and any process involving curing or treatment of solid material in contact with steam, air, or gases under specified temperature and pressure conditions.

Blaw-Know engineers will be glad to discuss possible applications with you.

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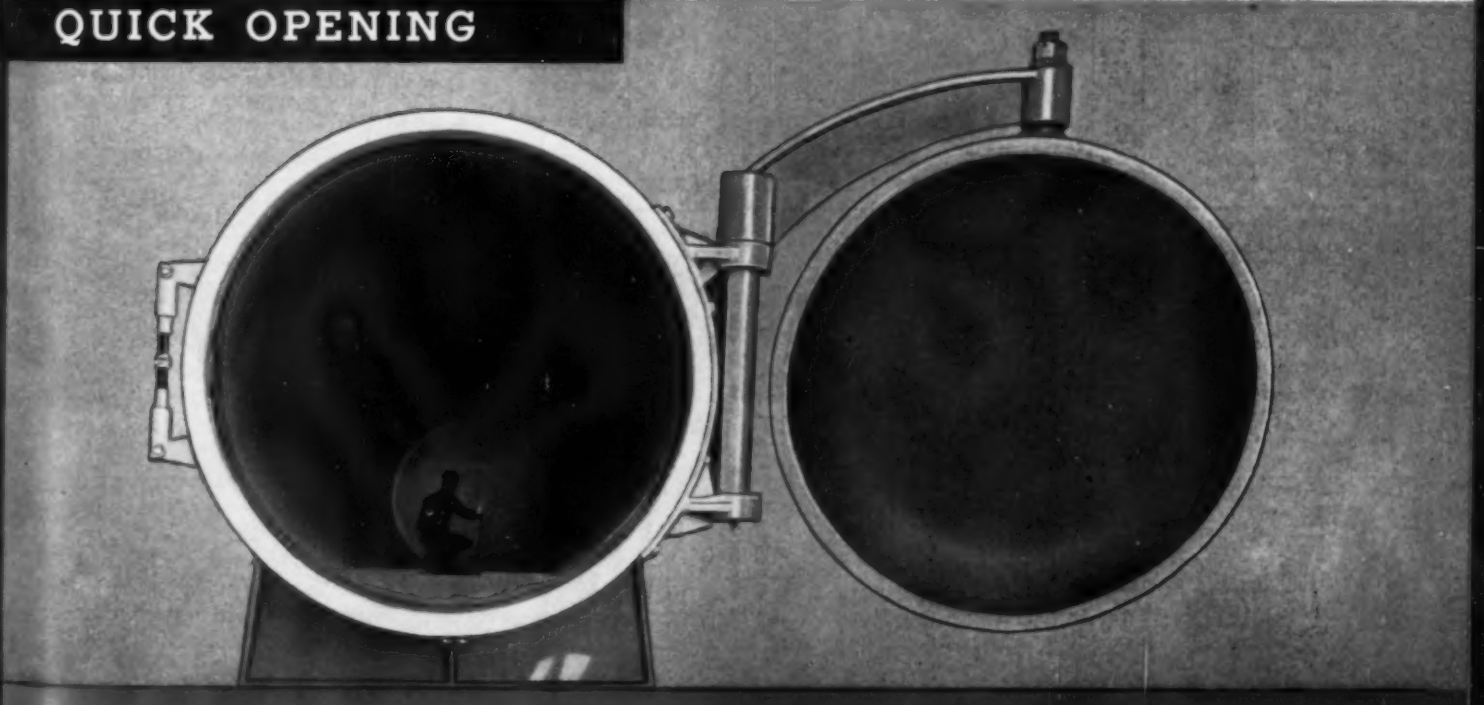

BLAW-KNOX IMPLEMENTS THE PROCESS INDUSTRIES

paper coatings, adhesives and plastic moldings. Shipped as light colored granules, Darex Copolymer X43 has a low specific gravity of 1.05 and a plasticity of 20 to 40 at processing temperatures of 212 to 250 deg. F.

Increased hardness and stiffness, resistance to water absorption, good compressive set and electrical characteristics are some of the properties imparted by this resin to natural and synthetic rubbers. When used as a reinforcing filler for GR-S, X43 gives increased abrasion resistance, higher modulus and improved flex-life. Small amounts improve handling in mixing calendering and molding of stocks highly loaded with mineral pigments.

59. Insecticide Solvent

DEVELOPMENT of a new petroleum product which, coupled with DDT or other chemicals, is successful in exterminating such outdoor pests as mosquitoes, houseflies and grasshoppers was recently announced by the Socony-Vacuum Oil Co., Inc., 26 Broadway, New York 4, N. Y. Designated S/V Sovacide F, this product is claimed by the manufacturer to be a new and potent weapon in the war against undesirable insects in forests and non-agricultural areas. Its use on farm crops is still experimental.

This petroleum derived solvent was developed for use in aerosol fogging, which is used in controlling insects over wide or relatively inaccessible areas. Such fogs, generated under heat and ejected by special fogging equipment, are formed of finely-dispersed solvents in which DDT or other insecticides have been dissolved. Sovacide F has been tested successfully and used under a variety of outdoor conditions in many parts of the country and is available now in commercial quantities.

60. Air Hose

ADDED strength and lightness are claimed for a new Highflex air hose made by the B. F. Goodrich Co., Akron, Ohio. For use with small tools, the hose is said to be flexible as a lamp cord. In the ¾ in. size the new hose weighs only 8.8 lb. per 100 ft. while the same size hose of ordinary design weighs 20 lb. for the same length. Oil proof, inside and out, the new hose is not affected by lubricating oil, will not swell to cut air pressure or volume, and will not flake off and cause the tool to jam or choke with rubber particles. Working pressures with the new hose go as high as 250 psi. with complete safety. The hose braid is designed for strength at the angle of maximum stress and the tube

Why not use one oil for all your hydraulic systems?

STANOIL Industrial Oil

Are you using two or more special oils to take care of the various hydraulic operations in your plant? If so, you may find it profitable to shift to Stanoil. It has proved its ability to improve hydraulic operation through a wide range of service. Take for example these two different applications.

Greater Reliability

After three years' operation in the large hydraulic press, shown at the right, the original fill of Stanoil showed only a trace of oxidized oil and no appreciable change in viscosity. Because of the high stability of Stanoil, the hydraulic system stayed clean and the hydraulic controls functioned smoothly at all times.

Little Maintenance

A switch to Stanoil in the hydraulic feed mechanism, shown at the right, stopped varnish trouble and eliminated the frequent cleaning jobs required with the use of a conventional oil. Where previously the hydraulic oil had to be changed every three months, the original fill of Stanoil has shown practically no deterioration after three years of service.

Stanoil contains an oxidation inhibitor and an anti-foam additive that contribute to long oil life and clean, reliable operation of hydraulic units, speed reducers, and circulating systems. A Standard Oil Lubrication Engineer will help you put this economical oil to work in your plant. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY (INDIANA) STANDARD

FOR MORE INFORMATION
See Reader Service Coupon on pages 159-160

and braid for minimum expansion under pressure. The manufacturer states that the hose cover will not tear or snag easily; the lighter weight causes less abrasion, it resists sun checking and takes up little storage space.

61. Wax Modifier

AN IMPROVED paraffin wax modifier has been recently announced by Esso Standard Oil Co., 15 West 51st St., New York 19, N. Y. Known as Tervan 2800, it is a blend of refined paraffin wax and high molecular weight Vistanex (polyisobutylene). It is odorless, tasteless, and colorless and when blended with crystalline wax, in any of a wide range of ratios, imparts better qualities of viscosity, adhesion, water and water-vapor impermeability, etc. It is inhibited against oxidation and replaces three former products, Tervan 349, Tervan 449 and Tervan 3315.

Tervan 2800 is claimed to be useful as a paper coating. Coated paper wrapping is now used as a preservative and a protection on almost every type of product, both perishable and imperishable, and the paraffin wax coating is often required to serve as both the barrier and the adhesive over a wide temperature range. It is in this field that paraffin wax has exhibited some of its shortcomings, especially in packages such as those used for frozen foods, which are subjected to handling at low temperature. Paraffin wax-coated paper is used in many applications where its relatively low cost is economically desirable. The use of Tervan 2800, therefore, is limited to applications where improved performance outweighs its higher cost. It is also suggested for use for practically all industrial applications where paraffin wax is used such as textile processing, rubber compounding, etc.

62. Enamel for Aluminum

SUITED for factory-finishing of aluminum intended for outside exposure, a synthetic heat-hardening low-gloss enamel has been developed by the Sherwin-Williams Co., Industrial Div., Newark, N. J. It has been adopted by a producer of pre-painted aluminum siding where it has eliminated the

NEW Lapp PULSAFEEDER

Piston-Diaphragm Proportioning Pumps

THE *Only*

CHEMICAL PROPORTIONING PUMP THAT OFFERS *ALL* THESE ADVANTAGES

NO STUFFING BOX, no mechanical or liquid seal, absolutely no packing or other "leak-likely" gland can be in contact with liquid being handled.

HYDRAULICALLY-BALANCED diaphragm isolates chemical from pump parts.

NO CONTAMINATION. Product is protected from lubricants and from contact with atmosphere.

MICRO-ADJUSTABLE to any rate of flow by calibrated handwheel, while pump is in operation.

PERFECT LUBRICATION with all moving parts submerged in oil bath.

FOR CONTROLLED VOLUME PUMPING OF FLUIDS. The exclusive Pulsafeeder design principle provides continuously accurate feed rate through measured piston displacement, plus complete isolation of chemical and freedom from contamination through its hydraulically-balanced diaphragm. The new heavy-duty CP series Pulsafeeder is available in single-head and duplex models in four sizes, ranging in capacity from less than 100 ml. per hour to 660 gallons per hour; pressures up to 2250 psig.

SEND FOR NEW BULLETIN, No. 202, which carries complete description and specifications. Lapp Insulator Co., Inc., Process Equipment Division, 331 Maple St., Le Roy, N. Y.

Lapp *Process Equipment*

CHEMICAL PORCELAIN VALVES
PIPE • RASCHIG RINGS
PULSAFEEDER PROPORTIONING PUMPS

need for painting after the siding has been applied. The manufacturer expects it to be valuable on aluminum storm-window sashes, fencing, spouting and other types of building products. When it is spray-applied under ideal conditions and fast-baked, it is said to be equal in hardness to refrigerator finishes.

Company tests have shown the finish to be resistant to 2,000-hr. accelerated weatherometer exposure and 1,500-hr. salt spray exposure. It has also withstood 50 cycles of a heat and cold test during which there was noticeable expansion and contraction of the aluminum base. Sherwin-Williams engineers suggest that, after proper surface preparation, the aluminum be roller coated with primer and baked, then fabricated and sprayed with the finish bake coat. Or, both the primer and finish coat may be applied after the metal has been fabricated.

63. Fine Abrasives

Two high-purity alumina powders of small and uniform ultimate particle size are now being made in commercial quantities by the Linde Air Products Co., 30 East 42nd St., New York, N. Y. Both are white powders, unaffected by common acids. Type A is a hexagonal crystal with particle size of 0.3 microns and a true density of 4.00 g. per c.c. Type B is a cubic crystal with a particle size of less than 0.1 microns and a true density of 3.6 g. per c.c. In sharpening, honing or polishing work type A removes stock faster than type B, but type B produces a superior finish. Depending upon the application, these abrasives may be used dry or mixed with water or other vehicles to make a thin slurry or heavy paste. They have also been compounded with waxes to provide a convenient stick form. They are suggested for use as catalyst carriers.

64. Oil Additive

A MAGNESIUM type detergent-dispersant for compounding premium and heavy duty lubricating oils is being made by Monsanto Chemical Co., St. Louis 4, Mo. Designated Santolube 222, it imparts a high degree of detergency at a relatively low concentration. Because of its lower ash content and potent detergent qualities, the manufacturer states that it is more effective than many more expensive detergents based on heavier metals. In suitable base oils Santolube 222, at 1.9 percent by volume with 0.66 percent by volume of Monsanto's oxidation inhibitor Santolube 394-C, meets U. S. Army Specification 2-104B.

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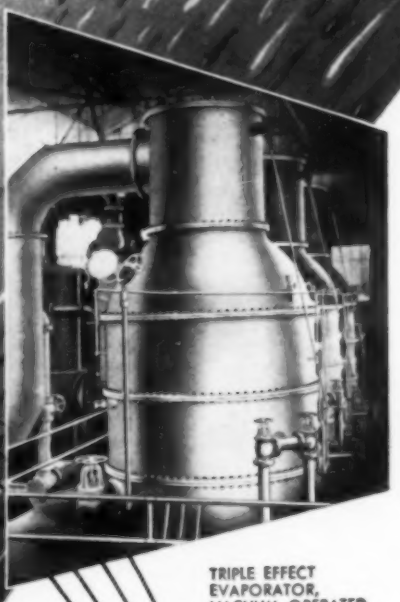
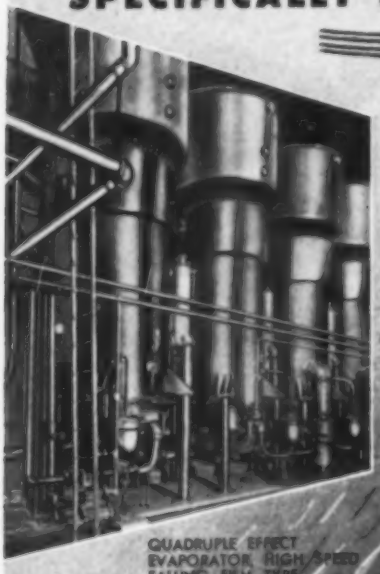


TRIPLE EFFECT EVAPORATOR, VACUUM OPERATED



QUADRUPLE EFFECT EVAPORATOR, HIGH SPEED FALLING FILM TYPE, MADE OF SPECIAL ALLOY

EVAPORATING UNIT

SUGAR VACUUM PANS

To produce high quality products for many diverse industries, through rapid, more efficient heat exchange, Acme evaporators are individually designed for each specific application. Entrainment losses and fouling, as well as local overheating, are reduced to a minimum, while important savings are made in steam and water consumption. Corrosion problems are solved by the judicious selection of materials of construction to achieve a balance between long operating life and initial investment. Acme engineers are prepared to study your specific evaporation problem before submitting their recommendations.

WRITE FOR BROCHURE CE-48

ACME

Processing Equipment

ACME COPPERSMITHING & MACHINE CO., ORELAND, PA., U. S. A.

Roger Williams, Jr., ASSISTANT EDITOR

Pension Plan Comparison

Different companies have vastly different pension plans. This survey of 31 chemical companies indicates the magnitude of the variation, gives provisions of average plan.

LAST month's story, about the labor trouble at Oak Ridge due partially to employee benefit plans, leads one to wonder how widely some of the benefit plans in the chemical industry vary. To find out, we asked a lot of chemical companies for copies of their benefit plans. Some 31 companies* responded with partial or complete information on such things as pensions, group life insurance, vacations, hospitalization, disability payments, and so forth. To review all the information in one month would take more space than is available, so this month we will compare 20 pension plans on which complete data were received.

Perhaps the most striking thing about the pension plans is the tremendous variation among them. Suppose we start out by assuming a hypothetical young chemical engineer. He has a Bachelor of Science degree, is 25 years old, and starts to work at a salary of $260 per month. Let us assume further that he gets a raise of $16 per month every year until he retires at age 65, the age all companies surveyed set for retirement. (That's about the only similar thing in the plans.) That means the year he retires he will be getting $900 per month. Such a salary progression just about matches some of the published surveys made recently.

Well, what kind of a salary will this young engineer retire on some 40 years from now? The answers are shown in the table, for each of the companies surveyed. The results show that companies can be grouped into two classes: those which provide pensions at no cost to the employee, and those where the company and employee join to purchase an annuity for the employee.

If we consider the pensions in the first group, they range from a high of over $5,000 per year to a low of about $2,700—a considerable range. In most cases the company sets up a pension based on the employee's past earnings, and then deducts any governmental pensions (Social Security) from what it pays the pensioner. This seems unduly complicated but is the general rule. In a few cases the pension is based on the employee's earnings during the last ten-or-so years before retirement. This results in a higher base (and higher pension) than those plans which average an employee's earnings over the whole time he has been with the company.

The second group, where the employee participates in buying an annuity, are mostly the plans of insurance companies. All the big ones are represented, such companies as Equitable, Metropolitan, Aetna, Prudential, Bankers Life, Travelers. Often the same insurance company is involved in different chemical companies' plans, yet the rates and provisions are different. The pensions coming to our hypothetical engineer from these plans vary from a low of $3,800 a year to a high of $5,900, again quite a range is shown.

The thing that is interesting is that the employee's payments don't jibe with the pension. In one company the employee pays out $9,800 for his annuity over the 40 years he works, and he gets a $5,600 pension. In another, he pays out about the same sum from his salary, but his pension is only $4,600. This makes little sense until

Pension Plans of Twenty Companies

Assumptions: Employee begins work for each company, at age 25 and a salary of $260 per month, receives raise of $16 per month each year until retirement at age 65.

Company	Eligibility Requirements	Total Amount Contributed by Employee During His Employment	Annual Pension Received Under Plan	Annual Social Security Pension	Total Annual Pension
1	20 yr. service	——	$4,368	$684	$5,052
2	15 yr. service	——	3,936	——[1]	3,936
3	25 yr. service	——	3,936	——	3,936
4	5 yr. service, age 30	——	3,118	684	3,802
5	None	——	3,534	——	3,534
6	None	——	2,784	——	2,784
7	3 yr. service, get $2,400 per yr.	——	2,040	684	2,724
8	1 yr. service	$12,510	5,215	684	5,899
9	1 yr. service	9,822	4,910	684	5,594
10	1 yr. service, age 25	9,000	4,500	684	5,184
11	1 yr. service, get $2,400 per yr.	12,583	4,350	684	5,034
12	1 yr. service	11,095	4,265	684	4,949
13	1 yr. service, age 30	9,385	4,170	684	4,854
14	5 yr. service[2]	10,160	4,044	684	4,728
15	5 yr. service	9,870	3,950	684	4,634
16	2 yr. service[3]	10,660	3,510	684	4,195
17	1 yr. service, get $2,000 per yr.	9,485	3,320	684	4,004
18	1 yr. service, age 25	8,070	3,220	684	3,904
19	3 yr. service, age 25	8,510	3,192	684	3,876
20	1 yr. service, age 30[4]	6,990	3,830	—	3,830

[1] Where no payments are shown under Social Security, any such governmental pensions are deducted from the pension paid by the company under its plan.

[2] This company has two plans, a pension plan for which eligibility is 5 yr. service, and an annuity plan which requires 5 yr. service and an income from the company of over $3,000.

[3] This company has two plans, one for wage-roll employees and one for salaried employees. The figures shown are for the salary plan.

[4] This company has two plans. The first is paid entirely by the company and covers remuneration up to $3,000; requirement for eligibility is age 30; Social Security payments are deducted from the pension. The second plan is a participating annuity plan for employees earning more than $3,000; requirements are age 30 and 1 yr. service.

* Abbott Laboratories, Air Reduction Co., American Potash & Chemical Corp., American Smelting & Refining Co., Atlas Powder Co., Celanese Corp. of America, Davison Chemical Corp., Dow Chemical Co., Du Pont Co., Eastman Kodak Co., Ethyl Corp., General Aniline & Film Corp., Harshaw Chemical Co., Hercules Powder Co., Hooker Electrochemical Co., Industrial Rayon Corp, International Minerals & Chemical Corp., Koppers Co., Lion Oil Co., Merck & Co., Monsanto Chemical Co., Nopco Chemical Co., Pennsylvania Salt Mfg. Co., Chas. Pfizer & Co., Phillips Petroleum Co., Rohm & Haas Co., Sharpe & Dohme, Sterling Drug Inc., Texas Gulf Sulphur Co., U. S. Industrial Chemicals, and Victor Chemical Works.

one realizes that the deviation is in the amount of money the company is putting up, along with the amount paid by the employee over the years.

The net result is that only two of the whole series of companies have essentially identical plans. The fact that those two companies are located in the same city may have something to do with it.

The differences in plans are graphic. They point out one thing that the young engineer, looking for a job, might well take into account. They are something that unions are increasingly considering. The recent Inland Steel case stepped up union interest when the Court ruled that pension plans and the like are proper problems for collective bargaining. That means unions will be sitting in when pension plans are considered in the future.

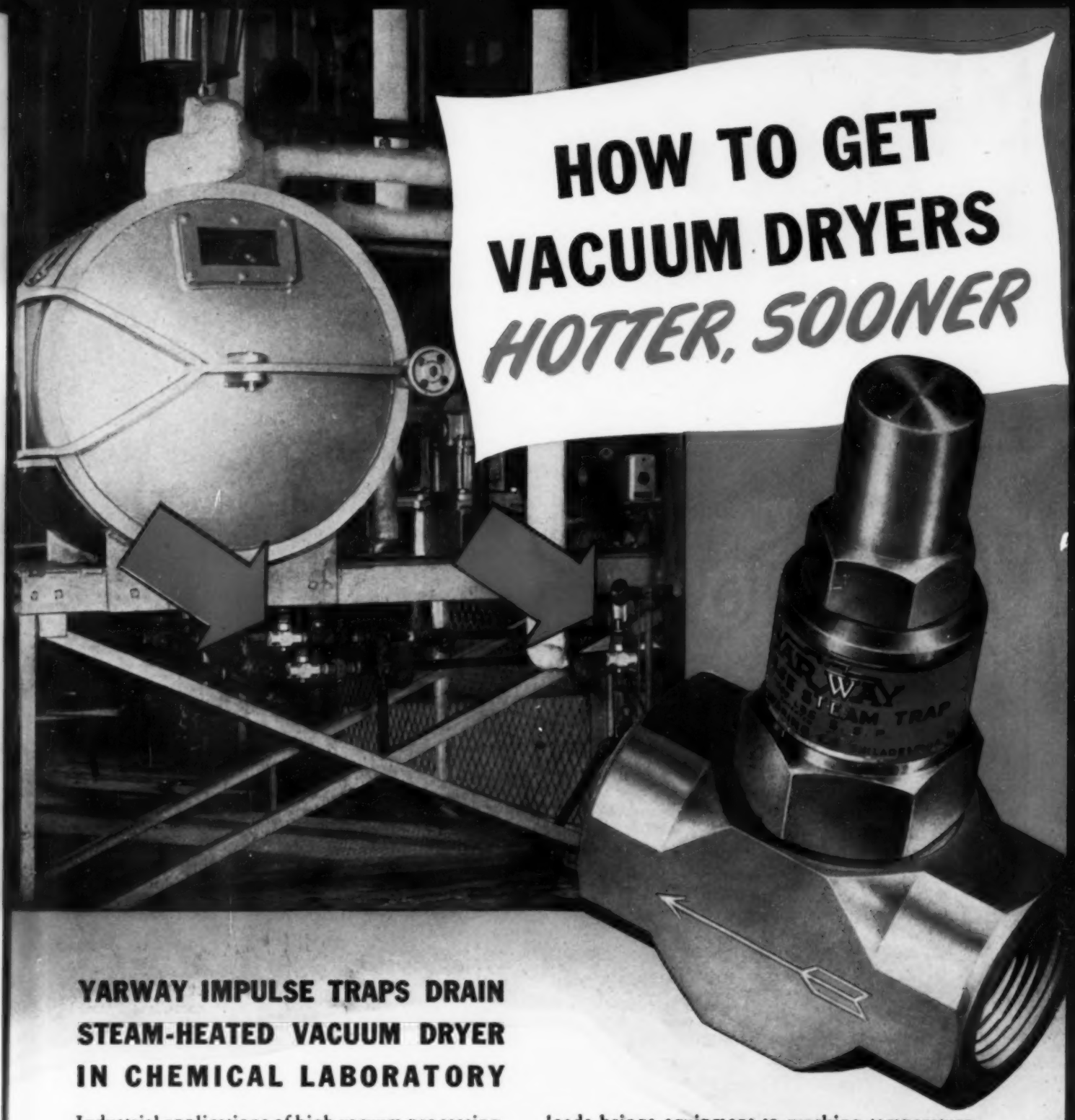
With this in mind, perhaps it is worthwhile to consider a composite average pension plan. Bankers Trust Co. has recently completed a survey of some 289 retirement plans, covering about 30 percent of the employees who are working under regular pension plans. Here are their findings:

The general tendency is toward greater coverage of employees, less restriction of plans to higher salaried personnel. Eligibility requirements are usually less than five years service and often include an age requirement of 30 or less. A retirement age of 65 is almost universally used for men. Companies usually retain full control over the retirement of employees before 65. There are usually maximum allowed pensions, although the figure varies widely, ranging from $3,000 to $35,000 per year.

Here's what Bankers Trust says about paying for the plans: "It is universal practice for the company to assume the entire cost of the employees' benefits which are based on service prior to the adoption of a plan. However, it is not uncommon practice to require the participant to pay part of the cost of benefits based on subsequent service. In about half of the 289 plans, the cost of future service benefits is paid in part by the employee, and in the other half, the company pays the entire cost of these benefits."

The Bankers Trust findings seem to be substantiated by the chemical industry plans we have surveyed.

Now let us turn to another phase of pension plans. That is the little handbook given out to employees to explain to them what the pension plan is all about. It has two functions: to *sell* the employee on the value of the plan and get him to



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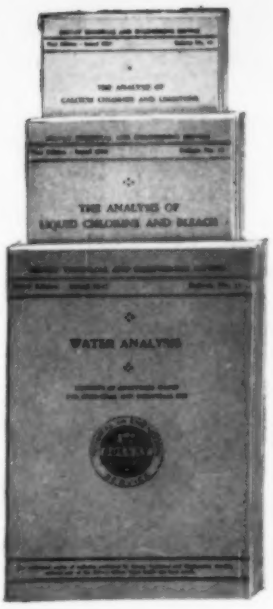
join it, and to *sell* the employee goodwill. No company has a labor relations policy just based on altruism; a profit is expected because contented, interested employees will do more work, have more ideas.

Reading the booklets these 30-odd companies are now furnishing their workers is a revelation. If any employee pamphlet is going to sell an employee it has to be understood readily. There are some examples below of readability. Another thing the booklets have to do is to give the employee information. He needs information to decide whether or not he wants to join the plan, if he is not in it automatically. In most plans, once you sign up you cannot drop out. So an employee ought to know what the deductions will be before he signs away a permanent deduction from his pay. The best booklet received, from a readability angle, could not be included in our comparison because it does not tell what the deductions will be, *nor* how much the pension will be.

Now let us consider readability. Here's the first example and perhaps the best: "Notwithstanding anything in this Article or elsewhere in the Plan provided, but not in limitation or derogation of the rights of the Company under Article X, in the event that said Primary Insurance Benefit now provided under said Federal Social Security Act shall be increased for any present or future employee or group of employees of the Company, by or pursuant to any future applicable Federal law, or in the event that other pensions or comparable retirement benefits shall be provided for any present or future employee or group of employees of the Company, by or pursuant to any future law of the United States or of any State, county or municipality, the Company expressly reserves the right under the Plan, and as a condition to its adoption, to amend the Plan so as to decrease the amount of pension payable under the Plan to each such employee, whether or not then retired under the Plan, by an amount corresponding to such increase in Primary Insurance Benefit and/or State or other retirement benefits so payable to him."

It seems doubtful that many employees would read, much less understand, that paragraph. Here's another example which appears in most of the booklets that are obviously written by insurance companies.

"An employee may elect to receive at his normal retirement date a reduced amount of retirement annuity in order to provide that the same or any specified part thereof is to be continued, in the event of the employee's death after his normal retire-



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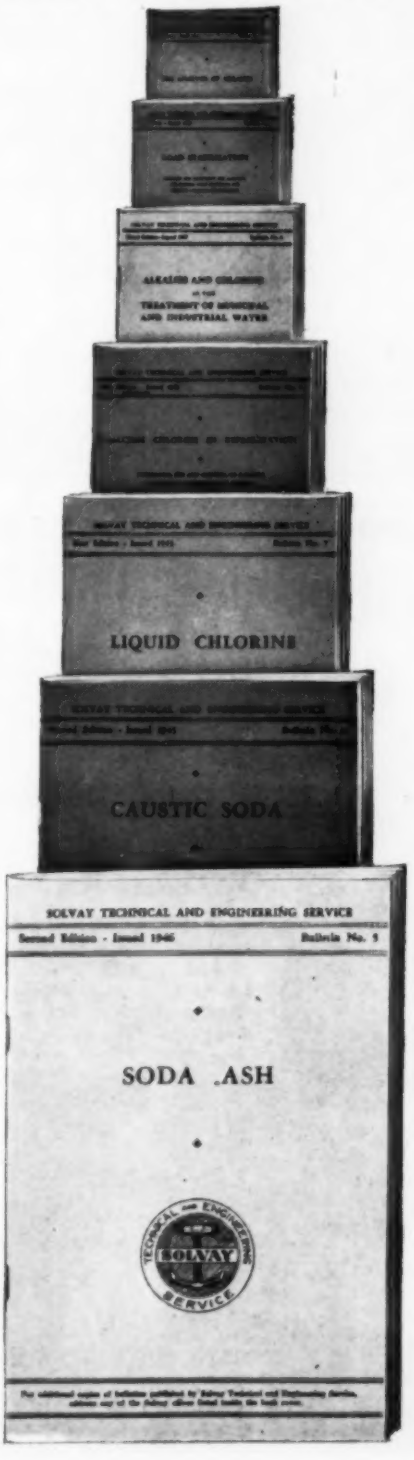

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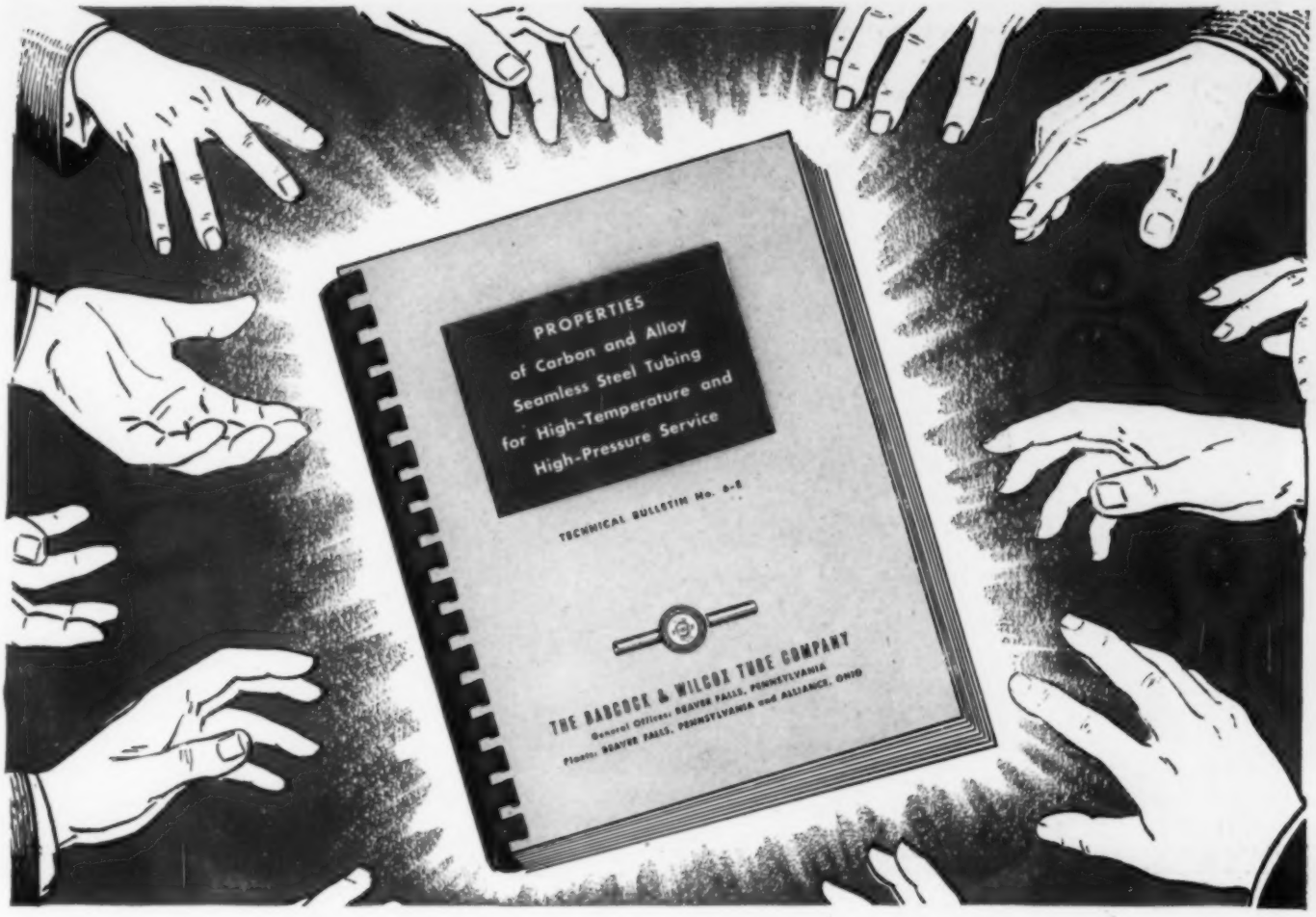
ment date, to a designated person during the remainder of the life of such designated person. The amount of the reduced annuity under this option depends upon the age and sex of the employee and of the designated person, and on the proportion of the employee's reduced annuity which he specifies is to be paid to such designated person."

Just one more: "Upon receipt of proof, satisfactory to the Retirement Board, of the death of a Member prior to retirement who has completed five or more years of membership service, 20 percentum of his accumulated profit distributions at the time of his death, plus an additional 4 per centum of such accumulated profit distributions for each year of membership service in excess of five years but not in excess of 25 years, shall be paid in one sum to the person nominated by him by written designation duly acknowledged and filed with the Retirement Board, if such person survives him, otherwise to the estate of such deceased Member; provided that the full amount of accumulated profit distributions shall be paid if the deceased Member had attained age 65, or has attained age 60 and completed 10 years of creditable service, or if he had deferred his retirement pursuant to Subsection (2) (c) of this Section 4."

We mentioned something before about putting in the data necessary to calculate deductions and pensions. We might add parenthetically that two of the booklets we received contain all the data, but they are so complicated that we frankly could not calculate the pension information to include in the table. The examples are clear, but they contain a catch phrase: "assuming no change in earnings." Frankly we do not know how to figure a pension from these tables when the employees get a raise.

Then there is another thing which bears on the good-will a company can get from its pension program. Most of the companies with annuity-type plans state that they are putting up one or two dollars for every dollar the employee contributes. The ones that do not give the figure are missing a bet. It is good employee relations to let workers know how much employee benefits are costing a company.

Admittedly the above has been critical. Perhaps it will do some good. But despite the criticism the chemical industry can be proud of the fact that it is out in front in pension plans. There are only some 3,300,000 employees in the United States covered by pension plans. The chemical industry has a far higher percentage covered than industry as a whole. Of that fact it can reasonably boast.



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CHEMICAL ENGINEERING NEWS

Richard F. Warren, ASSISTANT EDITOR

For Achievement in Plastics . . .

President Truman presents the John Wesley Hyatt Award to John D. Cochrane, Jr., Formica Insulation Co., as Mrs. Cochrane and distinguished guests look on.

Industrial Mobilization May Get Researchers

TOP AUTHORITIES of the military establishment are struggling with the problem of deferment of technical personnel without much apparent success. The only major change from 1942 that is clearly evident is the recognition high up that taking research personnel by indiscriminate enlistment, draft, or reserve calls, may do more damage than good.

Specific questions have been asked of Munitions Board representatives regarding three features. Their tentative answers are illuminating.

No over-all exemptions by classes, such as technical or research personnel, are contemplated at all. Such would not be compatible with Congressional mandate.

Research work being done by an individual otherwise subject to draft will be definitely considered, and may be the occasion for encouragement of deferment by the military themselves. But if such technical person changes his job, then a new basis for deferment must be established with his new local board. It is not expected that general deferment for research will be granted, even to a highly skilled individual unless he continues attached to a specific wanted task.

A special committee has been working on the problem of disrupting technical and research organization through military calls on reserve officers. It is expected that this problem will be solved by review in the Munitions Board, top policy agency. It is categorically stated that the Munitions Board feels almost as keenly on the subject of disrupting research organizations as does industry. Whether actions will implement that "keen feeling" remains to be seen.

On one feature all agree. Reserve officers and young technical men subject to draft must take action on their own behalf and with the aid of their employers. They must not expect Washington to take the initiative.

Humble Will Hold Lectures For Research Staff

HUMBLE OIL & REFINING CO. has named six university scientists to conduct the 1948–1949 Baytown Lectures in Science, a series of two-week courses designed to bring latest scientific information to the company's research workers at the Baytown, Tex., refinery.

Those selected are: Dr. R. L. Pigford, chairman of the chemical engineering department of the University of Delaware; Dr. J. W. McBain, professor of chemistry at Stanford University; Dr. B. F. Dodge, professor of chemical engineering at Yale; Dr. Henry Eyring, dean of the graduate school and professor of chemistry at the University of Utah; Dr. Paul D. Bartlett, professor of organic chemistry at Harvard; and Dr. F. A. Matsen, professor of chemistry and physics at the University of Texas.

Pigford was scheduled to open the series this month with lectures on the mathematics of chemistry and chemical engineering. Dodge and Eyring are slated for addresses early in 1949.

The 1947–1948 series closed in June with lectures by Dr. J. L. Hildebrand, professor of chemistry at the University of California, on "Thermodynamics of Non-Electrolytic Solutions."

Samuel P. Gibson

CMRA Elects Officers at New York Meeting

LAST month the Chemical Market Research Association held its annual meeting at the Hotel Biltmore in New York. The following officers were elected; president, Samuel P. Gibson, Commercial Solvents Corp.; vice president, L. H. Flett, National Aniline Division, Allied Chemical & Dye

Corp.; recording secretary, R. M. Prather, Standard Oil Co. of Indiana; corresponding secretary, E. I. Oppel, New Jersey Zinc Co.; and treasurer, E. H. Bohle, Jefferson Chemical Co. D. P. Morgan, Matheison Chemical Corp., and R. M. Jones, Barrett Division, Allied Chemical & Dye Corp., were elected councillors-at-large.

Dr. Charles R. Downs, consulting chemical engineer, spoke on the impact of tonnage oxygen on the American chemical industry. He was introduced by Dr. Foster D. Snell.

Celanese to Build Canadian Cellulose Pulp Plant

GRANTING of the first "forest management" license in British Columbia paves way for the proposed $25,000,000 rayon pulp mill of Celanese Corp. of America's Columbia Cellulose Co. at Port Edward, near Prince Rupert. The license covers several watershed areas and provides timber on a sustained yield basis. However, Celanese will probably buy logs for several years on the open market.

Clearing of the plant site is now under way and construction will start in October. Completion is expected some 18 months later. Already being built at York, Pa., is a $500,000 water filter. When finished, the plant will be capable of making 200 tons of highly purified cellulose pulp daily. Acetic acid and acetone will come from the company's plant at Bishop, Texas. Woods used: spruce, hemlock and balsam.

This makes the fourth pulp mill built or projected in British Columbia since the war's end. Recently put into operation was the venture of Bloedel, Stewart & Welch at Port Alberni, Vancouver Island, with a 200-ton daily output. Forest management licenses will probably be granted in the near future to MacMillan Export Co. on the east coast of Vancouver Island and to Canadian Western Lumber Co. at Duncan Bay on Vancouver Island.

Government Revises Support Prices on Naval Stores

DEPARTMENT OF AGRICULTURE on June 7 revised the support prices for naval stores products reducing the supporting loan rate for gum turpentine from 64.5 to 40 c. a gal. bulk, and increasing the resin rate from $7.09 to $7.97 per 100 lb., on K grade.

The change did not affect the current loan value of $131.58 per unit of 50 gal. of turpentine and 1,400 lbs. K grade resin. The resin fluctuation loan rate included $8.12 on X and WW, $8.02 on WG, $7.97 on N thru K.

Georgia and Florida producers have filled practically all available turpentine storage space and unless stocks can be moved rapidly a serious situation will develop. As a move to liquidate part of the stock on hand the American Turpentine Farmers Association had asked that the support level be dropped to 45 c. a gal. so that a better competitive market might be created.

Up to May 31 the Commodity Credit Corp. had become the owner of 573,238 gal. of turpentine, together with 2,363,107 gal. of 1947 carryover, on the basis of defaulted loans. This stock cannot be moved in domestic channels since the parity level is about $1 a gal. It is hoped that some means will be found whereby most of the nearly 3 million gallons in stock can be moved under ERP.

The situation in resin is not as serious as turpentine. There was practically no carryover from 1947 but so far this year approximately 9 million pounds have been placed on CCC loan and the height of the gum season is from now through next September. Stocks are accumulating at a high rate.

During May turpentine and resin prices presented a chaotic picture of the situation. Turpentine prices dropped to 46 c. while resin slid to $6.76 before recovery set in. Even now resin prices are under the loan value while turpentine is at the loan level.

Big factor in the gum spirits industry is the keen competition from wood spirits producers whose operating costs are lower and who are able to obtain FF resin, pine oil and dipentene as byproducts. Another factor is competition from mineral spirits which sells at a price about half that of wood spirits.

The industry feels that the slide in prices so far this year was squeezing out the far inflation. With present high support price it is feared that substitutes may come into greater demand which will adversely affect the industry economically in the future.

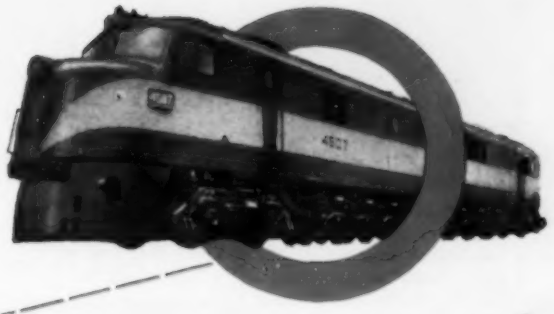
Bagasse Production Grows At Flintkote Hilo Plant

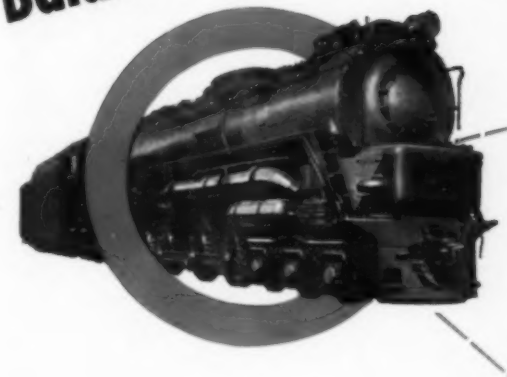
OUTPUT of wall and insulation board from Hawaiian sugar cane bagasse is being pushed upward—another step in the wider processing of agricultural wastes. Formerly discarded or burned as fuel in sugar mills, limited utilization came in 1932 with the formation of Hawaiian Cane Products, Ltd. Control of this firm has recently been acquired as the Canec division of Flintkote Co., Honolulu, T. H.

Canec has recently invested $500,000 at the Hilo factory, boosting capacity to 115,000,000 b. ft. yearly, an increase of some 18,000,000 over 1947 production. New installations: three

New SPI Officers . . .
Recently elected for 1948-49 term: Left to right, J. J. B. Fulenwider, treasurer; Neil O. Broderson, chairman of the board; Norman Anderson, secretary; George H. Clark, president; and Gordon Brown, vice president.

Baldwin Locomotive Works find





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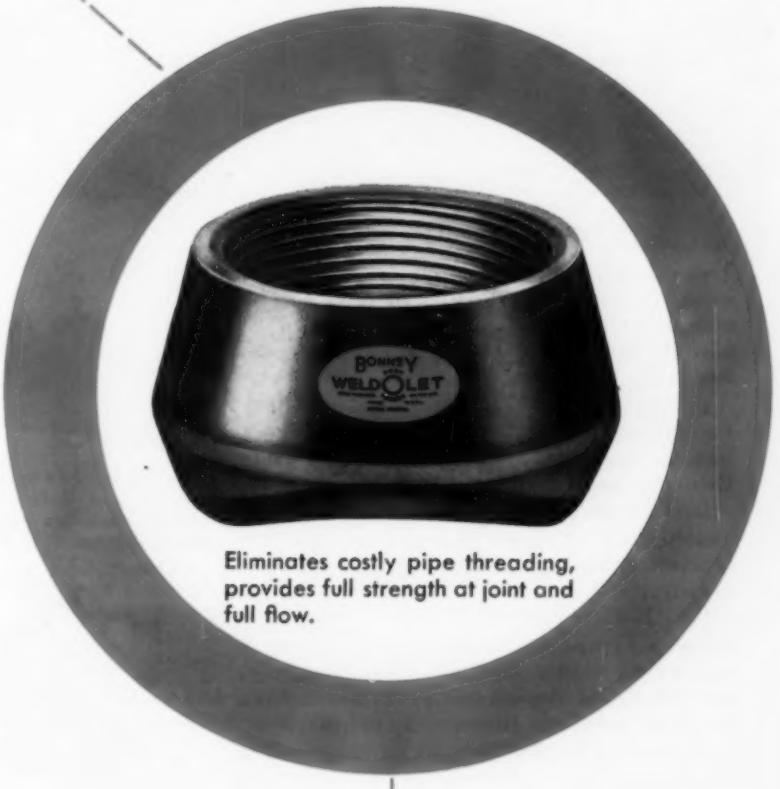

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Bauer refiners—making ten in all—and a second Jordan refiner. Estimates of bagasse consumption for this year run as high as 40,000 tons. However, this still represents only 20 percent of the Island's supply, 95 percent of Canec controls. Only other board of this type is manufactured in Louisiana.

Bagasse is the cane pulp remaining after all sugar has been removed. After cooking in rotary digesters for several hours, the resulting pulp goes to bins for draining and aging. Refiners further reduce the pulp, which is then washed free of all but pure fibers. Thickened, waterproofed and chemically treated for termite and rot control, it passes to the forming machines. A pressing operation removes some water and brings the wet mat down to required thickness. Wet board is cut into lengths of 6–16 ft. before entering the 400-ft. eight-deck driers. Final sizing, inspection and packing complete the process.

Special advantages claimed for bagasse board: greater structural strength, lighter weight, excellent acoustical properties, better resistance to termites and rot. Last year 40 percent of production was distributed on the mainland, in addition to the 25 percent

CONVENTION CALENDAR

Western Packaging Exposition, San Francisco Civic Auditorium, San Francisco, August 10-13.

American Chemical Society, 114th national meeting, Washington, August 30-September 3.

American Society for Engineering Education, third summer school for chemical engineering teachers, University of Wisconsin, Madison, Wis., August 30-September 4.

American Association for the Advancement of Science, centennial meeting, Washington, September 13-17.

American Institute of Chemical Engineers, regional meeting, French Lick Springs, September 15-17.

Third Instrument Conference and Exhibit, Convention Hall, Philadelphia, September 13-17.

National Plastics Exposition, Grand Central Palace, New York, September 27-October 1.

Fifth National Chemical Exposition, Coliseum, Chicago, Ill., October 12-16.

American Petroleum Institute, annual meeting, Stevens Hotel, Chicago, Ill., November 8-11.

American Oil Chemists Society, fall meeting, Pennsylvania Hotel, New York, N. Y., November 15-18.

used by Insulated Sidings, Inc., a partly owned subsidiary at Culver City, Calif. This year Flintkote will distribute products throughout the 11 Western states.

Remaining as head of the new division will be Frank H. West, former president of Hawaiian Cane. Manager of production is W. F. Goldsmith. Charles Mason is mill superintendent and Charles Atkinson is chief of research.

Three Lime Kilns Planned At Ashtabula

ELECTRO METALLURGICAL CO. plans to build three lime kilns, including screening and storage facilities, in Ashtabula, O. The new kilns will supply lime requirements for the company's calcium carbide furnaces. Gas producers for the gas to fire the kilns also will be built.

These new additions are separate from the company's $12,000,000 power plant for which the foundation work is now underway.

Alcoa Will Build Large Plant in Texas

ALUMINUM CO. OF AMERICA will erect an aluminum plant at Point Comfort, Tex., near Port Lavaca, Tex. The new plant will use natural gas for the generation of electric power. The plant site is on Matogorda Bay, in the area between Houston and Corpus Christi, and comprises over 3,000 acres. It will have an annual capacity of 70,000,000 lbs.

Present plans indicate that the project will be completed in about two years, according to I. W. Wilson, Alcoa's vice president in charge of operations, and Thomas D. Jolly, vice president and chief engineer for the company. Between 400 and 500 persons will be employed when full-scale operations get under way, they stated.

Installations at Point Comfort will include: a smelting or reduction plant with two potlines, in which aluminum will be produced from purified ore; a plant for manufacture of carbon electrodes required in the electrolytic process; a power plant and general service facilities. Construction is scheduled to begin in the immediate future. The electric generating equipment to be installed will have an 80,000-kilowatt installed capacity.

Docking facilities for the unloading of materials and supplies shipped to the plant by water will be constructed as part of the project. A railroad connecting the plant with the Missouri Pacific Railroad is planned. Purified ore for conversion into aluminum will

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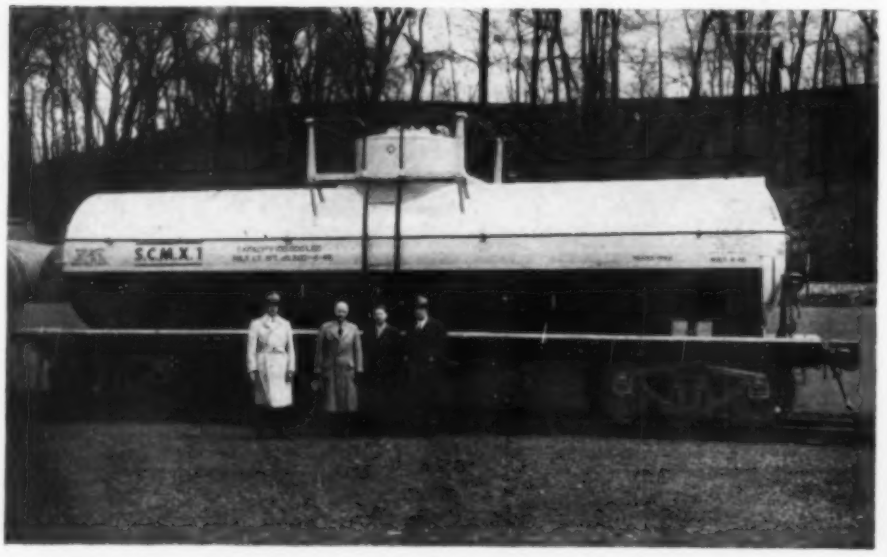
be obtained from the company's works at Mobile, Ala.

Four to six pounds of bauxite are required to make two pounds of alumina, which in turn are needed to make one pound of aluminum. In addition, three-quarters of a pound of carbon and 10 kwh. of electricity are consumed in the production of each pound of the metal.

Socony-Vacuum Opens New Research Structure

Housing modern and complete facilities for improving present petroleum products and for developing new ones, a new chemistry and physics building was recently opened by the Socony-Vacuum Oil Co., Inc., at Paulsboro, N. J. This building con-



SYNTHETIC GLYCERINE will be shipped in a fleet of aluminum tank cars. Here is the first of the cars that will haul Shell's new output at Houston.

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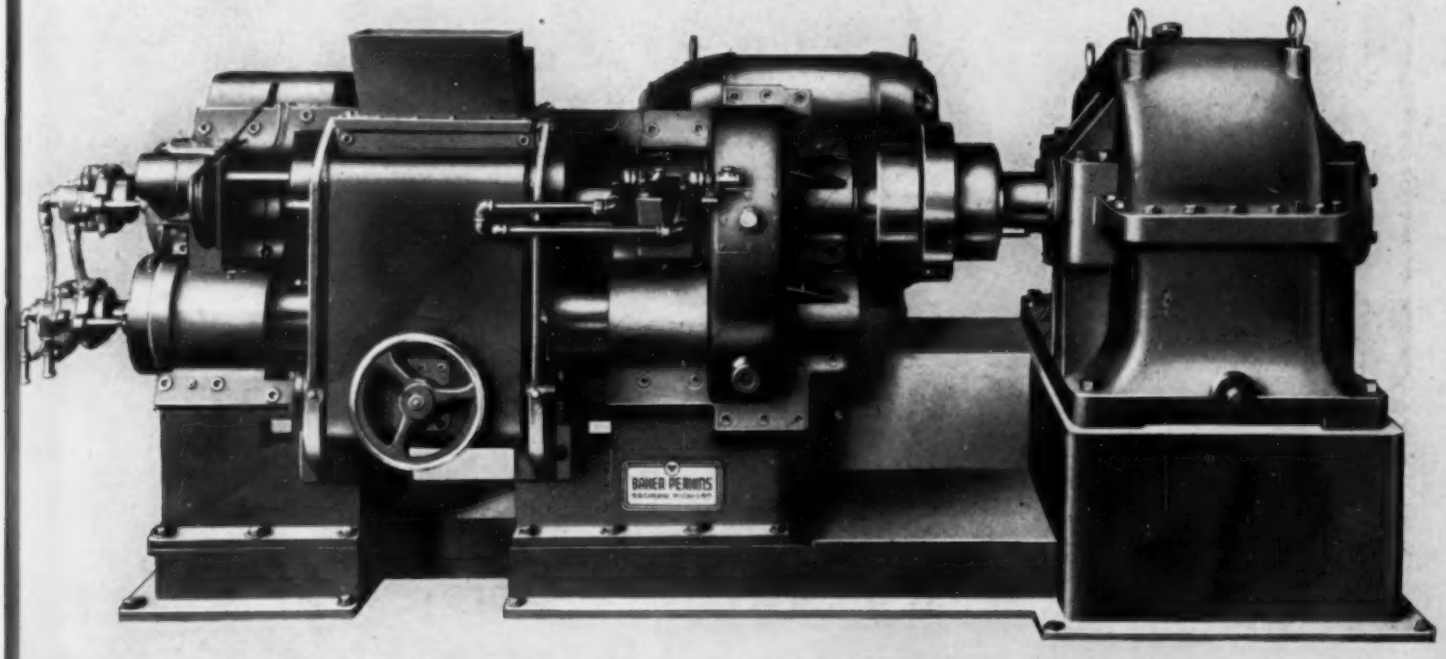

ing and cooling of blade surfaces. They are uniquely designed to *draw materials into the mixing zone,* eliminating need for ram or compression cover. Regardless of requirements, this B-P Masticator provides *positive* temperature control through the use of specially designed, jacketed mixing troughs and blades built to withstand pressures. These and many other features make the new Baker Perkins Masticator today's leading production mixer. *Get in touch with your B-P sales engineer.*

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tains the main laboratories for most of the fundamental research carried on by Socony-Vacuum and brings the total of buildings in the company's research and development department in Paulsboro to more than 12. In addition, it becomes one of the longest buildings of its type in the United States.

One activity of the new chemistry and physics building is the study of radioactive elements as tracers to assist in studying difficult lubrication problems. Another permits studies of chemical reactions by electronic methods. Still another brings together a host of precise apparatus for extremely intricate analyses.

Record Tung Nut Production Expected This Year

RECORD yield of tung nuts in Mississippi and Louisiana was established last year, and 1948 is expected to bring an even higher production, according to a Department of Agriculture survey released last month. In 1947 Lousiana plantations produced 18,700 tons of nuts having a market value of about $1.3 million. The Mississippi yield was 28,000 tons. The expectation of a large crop in 1948 is based on the growth of producing trees and the fact that a large acreage of young trees will come into production for the first time this year.

Rubber Research Plans Urged on the Military

RUBBER suitable for use at extremely low temperatures is a recognized urgent need of the military services. Extensive empiric and commercial trials of proposed materials for Arctic application are in progress. Little fundamental research has been done.

Proceeding from these facts, a special subcommittee under the Research and Development Board of the Department of Defense was named some months ago to review the problem. Three distinguished chemical engineers and research men of industry were chosen to prepare the preliminary recommendations. These were scheduled to be presented early in June.

The basic problem appears to be a determination of how rubber and other plastic materials may be modified so that they will not lose their resilience at low temperature or otherwise fail. It is not expected that the new research program, if and when adopted, will interfere with the present investigations and commercial developments of Army, Navy, or Air Force. But it is hoped that some of the fundamental reasons why plastics

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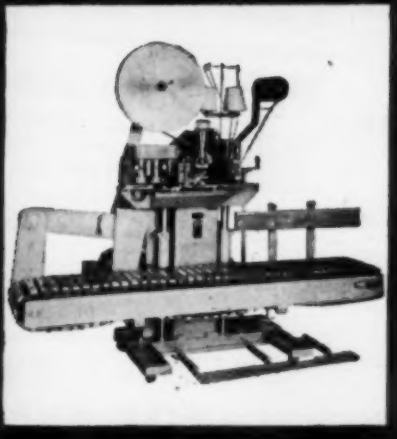

MODEL "DA" (Portable and built to last)—One operator filling and closing, can handle 2 to 4 100-lb. bags a minute . . . 6 to 12 a minute where filled bags are delivered to BAGPAKER conveyor (quickly adjustable for various bag sizes). Starting and stopping of sewing operation is automatic . . . no tape wasted.

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and rubber behave as they do may be discovered, and thus a more far-reaching plan of military procurement may be developed.

Iowa State Gets Two AEC Research Buildings

ANNOUNCEMENT was made at the cornerstone laying of Iowa State's metallurgy building last month that still another new research building would be constructed there. This new addition to the Ames Laboratory of the U. S. Atomic Energy Commission is to be a four-story concrete structure costing nearly $2,000,000 when equipped.

Tribute was paid to Iowa State College by Commissioner Waymack who made the announcement at the end of his cornerstone laying speech. During the war the Atomic Energy project took over considerable space in the College which is again needed for teaching and research, college enrollment having now risen to more than prewar normal. The new metallurgy and research buildings when completed next year will house the major portion of the federally financed research, development, and training work in atomic energy at that location.

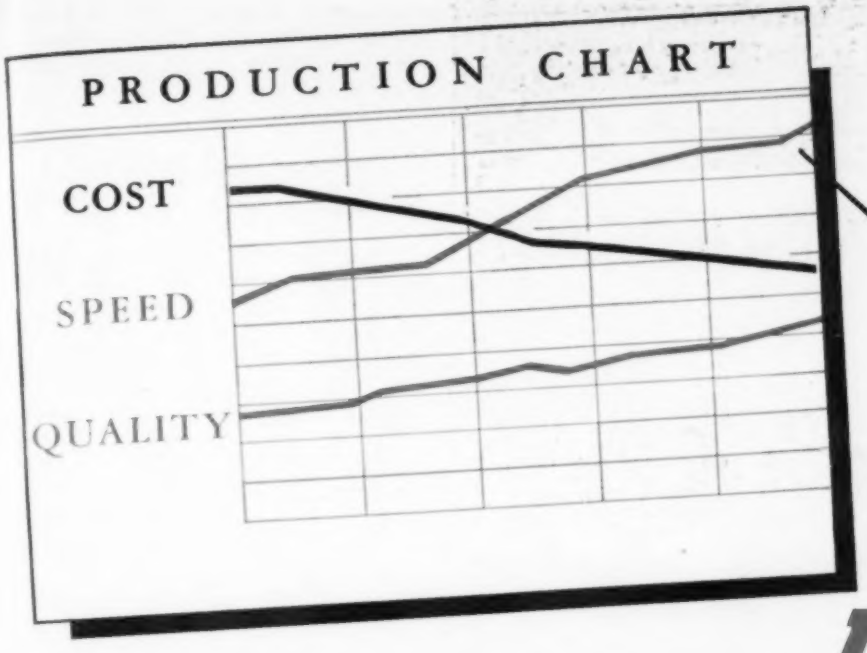
Potash Co. of America Expands New Mexico Operations

PRODUCTIVE capacity will be increased some 25 percent in an expansion program recently announced by the Carlsbad, N. M., mine and plant facilities of Potash Co. of America. Approximately $4,000,000 will be spent for mine equipment, sinking of two additional shafts and additions to the flotation plant. The latter installations include dryers, filters and thickeners as well as flotation equipment. Completion is expected by early 1949. Heading the project are P. S. Dunn, resident manager, R. G. Haworth, assistant resident manager and E. W. Douglass, research director.

Pittsburgh Plate Glass Will Expand Houston Paint Unit

PITTSBURGH PLATE GLASS CO. is installing additional mills in its paint and varnish plant near Houston, Tex., which will approximately double the present capacity of 25,000 gal. per week. Six additional mills at present being installed should be in operation some time this year.

In addition to making routine control analyses the plant operates a development laboratory which handles special problems in connection with



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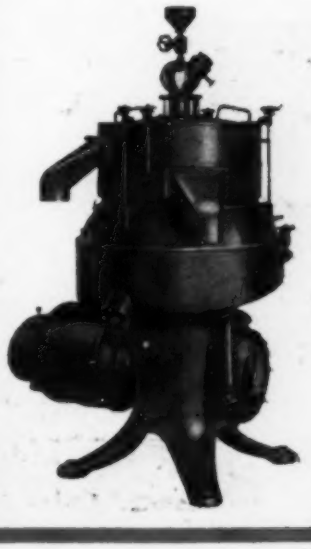

the application of its paints and varnishes. Control and development work is being handled by six paint technologists.

High-Grade Civil Service Positions Open

CIVIL SERVICE examination has been announced for filling high-grade chemist positions in the various federal agencies in Washington, D.C., and vicinity. The salaries range from $7,102 to $9,975 a year. One position paying $8,179 a year, in the Office of Naval Research, Boston, Mass., will also be filled.

To qualify candidates must have completed a college course leading to a bachelor's degree in chemistry, or must have had college study including 30 semester hours in chemistry plus appropriate education or experience which, when combined with the 30 semester hours in chemistry, will total 4 years of education and experience. In addition to meeting this basic requirement, candidates must have had four years of broad and progressive experience in chemistry. Graduate study in chemistry may be substituted for part of this experience.

A written test is not required. Candidates will be rated on their experience and training. The maximum age limit, 62 years, is waived for persons entitled to veteran preference. Applications will be accepted until further notice.

Applications for the position in Boston should be filed with the Director, First U. S. Civil Service Region, Post Office and Courthouse Building, Boston 9, Mass. Applications for all other positions should be filed with the Commission's Washington office.

PB Documents Made By Library

EFFECTIVE with the beginning of this fiscal year, July 1, reproduction of microfilms and photostatic copies of foreign industry information is being done exclusively by the Library of Congress. Office of Technical Services occasionally makes mimeographs, but these are definitely exceptions to the normal rule. Those wishing to order reproductions of PB items formerly secured through OTS should now place their orders with Library of Congress, Washington 25, D. C.

OTS continues in the Department of Commerce as a supervisory agency. But limited appropriations prevent it from rendering any reproduction service as heretofore. From this month, July, the Bibliography of Scientific and Industrial Reports is to be issued

monthly only and will include no abstracts. Subscriptions should, as heretofore, be placed with the Superintendent of Documents.

Lease Operation for Nitrogen Arsenals

WAR DEPARTMENT negotiations for long term leases of the arsenals still held as government property has not proven feasible. Hence a new plan is being set up to keep three and one-half such plants in operation so that they may do their best in helping meet domestic and export nitrogen-chemical requirements.

Short term leases will be continued on Morgantown, West Henderson, and Cactus Arsenals. It is expected that reactivation will be arranged for the two units of synthesis equipment which has been declared surplus property at Missouri Ordnance Works. The output of those two units is so badly needed for fertilizer supply that they are likely to again operate

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despite the high cost of the product. The other half of Missouri ordnance is already being remodeled by the U. S. Bureau of Mines to constitute its major synthetic liquid fuels plant.

The total of War Department production under leases of the three and one-half plants will be used for armies of occupation and to meet half of the export quotas under the international allocation system of IEFC.

Stanolind Starts Work At Garden City

PREPARATION of the site has begun for Stanolind Oil & Gas Co.'s hydrocarbon synthesis plant near Garden City, Kan. Crews began work this month to grade roads, fence the site, prepare drainage, level the points where the processing units will be built, install water and power service required in construction, lay railroad tracks and erect some buildings.

Major units of the project, which has been named the Stanosin Plant, are the oxygen unit, the synthesis gas generating and catalytic synthesis units and facilities for refining of the byproduct chemicals.

Armed Forces Chemical Association Meets at Edgewood

AT THE third annual meeting of the Chemical Corps Association it was voted to change the name to Armed Forces Chemical Association, in keeping with the broadened interests of the association and the consolidation of the armed services in the Department of National Defense.

Officers for 1948-49 were elected as follows: Harry A. Kuhn of Washington, D. C., was elected president, advancing from office of first vice president. Walter E. Lawson of Wilmington, was elected first vice president. Richard H. Turk of Baltimore, was elected second vice president, which post is automatically chairman of the finance committee. Elliott Morrill of Chicago, was elected third vice president and chairman of membership and organization. Alex Leggin of Washington, D. C., was re-elected fourth vice president and chairman of publications. Roy Kulp of Edgewood, Md., was re-elected fifth vice president and chairman of meetings and conventions. Walter R. Kirner was re-elected sixth vice president and chairman of research and development. Samuel Cummings of New York was elected seventh vice president and chairman of war mobilization planning.

Fred M. Jacobs was re-elected secretary-treasurer by the new executive committee, which also re-elected

Messrs. Pledger, Rodier, and Schwimer as general counsel, editor, and advertising manager, respectively. Schwimer's office is in New York, the other three in Washington, D. C.

Over 1,000 members and guests registered at the meeting at Edgewood on May 20 through 22. Visits to various activities of the Army Chemical Center featured the meeting. A demonstration of chemical warfare equipment on Friday afternoon was favored by perfect weather. Social and business activities supplemented the technical program.

Brookhaven Speeds Work On Atomic Pile

EMPLOYMENT for the construction of the first peacetime atomic pile at Brookhaven National Laboratory, Upton, N. Y. has been increased to more than 2,000 building craftsmen. The construction schedule step-up is an after-effect of the severe winter conditions which hindered rapid building progress, according to Mr. Thompson, vice president, H. K. Ferguson Co., in charge of engineering and construction. He said that the accelerated operation will enable builders to complete the pile by September 30th, the date originally scheduled.

Purchases for Stockpile May Be Speeded

HIGH Navy officers participating in policy making regarding the stockpiles of strategic and critical materials have expressed to Navy Industrial Association a number of trends in official thinking. Small buying for the stockpile has been occasioned more by desire not to interfere with industrial purchasing than by scarcity of funds, in the opinion of some of these officers. They believe that Congress has generally not refused any appropriation when really pressed by the military. This seems to discredit recent talk about Washington that the stockpile would grow much faster were it not for "Congressional economy."

There is obvious desire throughout the military establishment to speed up stockpile building. Recognized needs are not being met as rapidly as the preparedness group wish. Some speedup is definitely expected. But two features are being critically watched. (1) Price raising at the expense of American consumers will make buying smaller than otherwise, since it interferes with current industrial operations and often also slows down indirectly the industrial manufacture of wanted military equipment. (2) On the other hand, the United

States may be forced into the market, thus putting the national stockpile in competition with private buyers, "because some other governments not particularly friendly to us are aggressively making purchases."

Obviously our Munitions Board is not happy to have contemporary stockpiles built faster than ours. As of mid-June the American stockpile was valued at $660 million, according to Munitions Board estimates. The five-year goal (ending in 1951) would have $1,100 million total value. A completed stockpile, including natural rubber, would doubtless require investment of $3,000 million.

One In and One Out For Spencer

DURING the early summer War Assets Administration announced completion of all formalities for sale of the war-surplus Jayhawk Ordnance Works in Kansas to Spencer Chemical Co. Exercise of the company's option to buy involved a $11 million settlement fee. During June negotiations by Spencer to secure a long-term lease on Cactus Arsenal collapsed. Oronite Chemical has also been negotiating for the lease of that arsenal. But the best terms which Army engineers were willing to consider proved unacceptable, and discussions were broken off during mid-June.

Production of ammonia at Cactus Arsenal has been resumed following repairs made necessary by a serious fire there on March 6. Spencer continues its short-term lease operations despite breakdown of the long-term plans.

Army production here and at other short-term leased arsenals goes in part by law to fill American commitments abroad for nitrogen. Congress decided that half of the exports under IEFC quotas should be so supplied from the military establishments. Thus approximately a 60-thousand ton total of nitrogen will be half from commercial and half from arsenal sources. The present outlook is that nitrogen compounds from the United States will carry that quantity of nitrogen for the next year or two until foreign producers get underway more fully.

Chemical Engineers Club Elects in Washington

OFFICERS who will lead Chemical Engineers Club of Washington during the coming season were elected at the last outing-meeting as follows: president, John T. Cox, Jr., deputy director, Office of Rubber Reserve; vice president, Philip H. Groggins, Bureau of Agricultural and Industrial

Chemistry; secretary, Randall D. Sheeline, Navy Department; treasurer, Paul S. Forsyth, Office of Rubber Reserve.

At the end of the 1947-48 season this club had an active membership of 78 and a total of approximately 200 participating in its activities. Chemical engineers visiting Washington are welcome at the monthly informal luncheons, the third Monday of each month, without any advance reservation necessary.

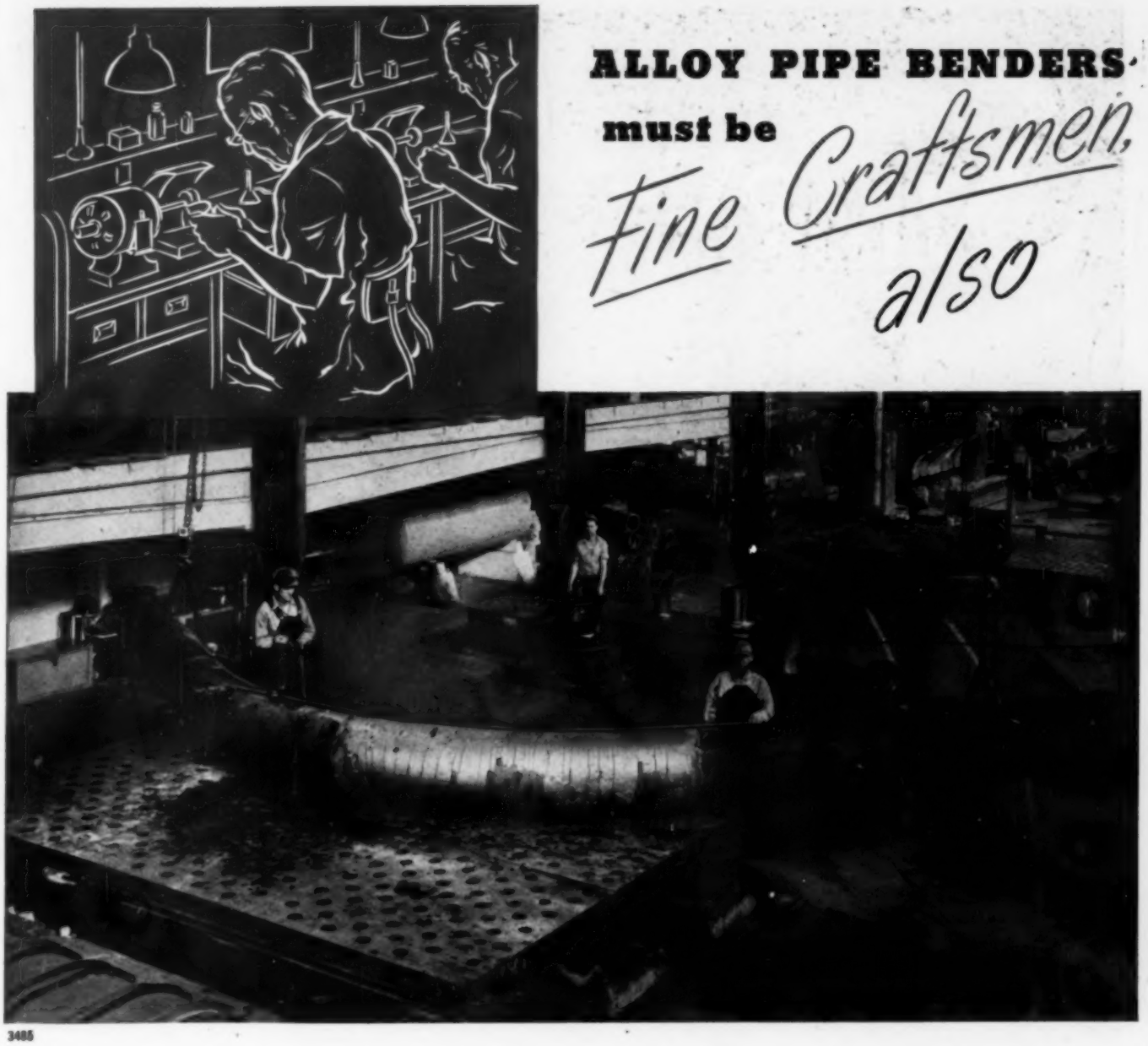
Shell Constructing Detergent Plant in Illinois

FIRST unit in what may become a complete synthetic detergent plant is being built by Shell Chemical Corp. at Wood River, Ill., according to W. P. Gage, vice president. The plant will process raw materials from Shell Oil's refinery in Wood River. This is part of the $9 million expansion that Shell has been pushing in the St. Louis area. Among other shell expansion projects in this vicinity are a new tank farm at Wood River and a marine terminal at St. Louis.

Water Removed From Lumber By Solvent Extraction

A SOLVENT method for drying pine lumber may soon prove to be an important Western source of turpentine, resin acids, fatty acids, pine oil and plant sterols. Albert Herman and A. B. Anderson of the Western Pine Association, Portland, are developers of the process which is now ready for pilot plant operations at the Shevelin-Hixon Co. mill at Bend, Ore. A survey to determine the market value of these byproducts, which will probably control economics of the process, is now under way, states Anderson, chief research chemist.

A water-miscible solvent extracts water from the lumber, which is stacked endwise in a tank. Solvent is sprayed over the wood at the rate of 100 gpm. Extracted organics and spent solvent are sent to a reboiler which returns part of the solvent to the extractor, the rest to a still. Here the organic materials rise to the top and are decanted; water and pitch are recovered as a partial emulsion. The lumber is treated with super-heated steam to reduce the solvent to about 0.02 percent of its weight. Water in the wood can be reduced to 3 percent, but 8 percent would be more practical in commercial operations. Solvent drying is said to be about four times as fast as the standard kiln-drying technique. It also gives a lumber of lighter color, less tendency to warp and easier to paint over knots.



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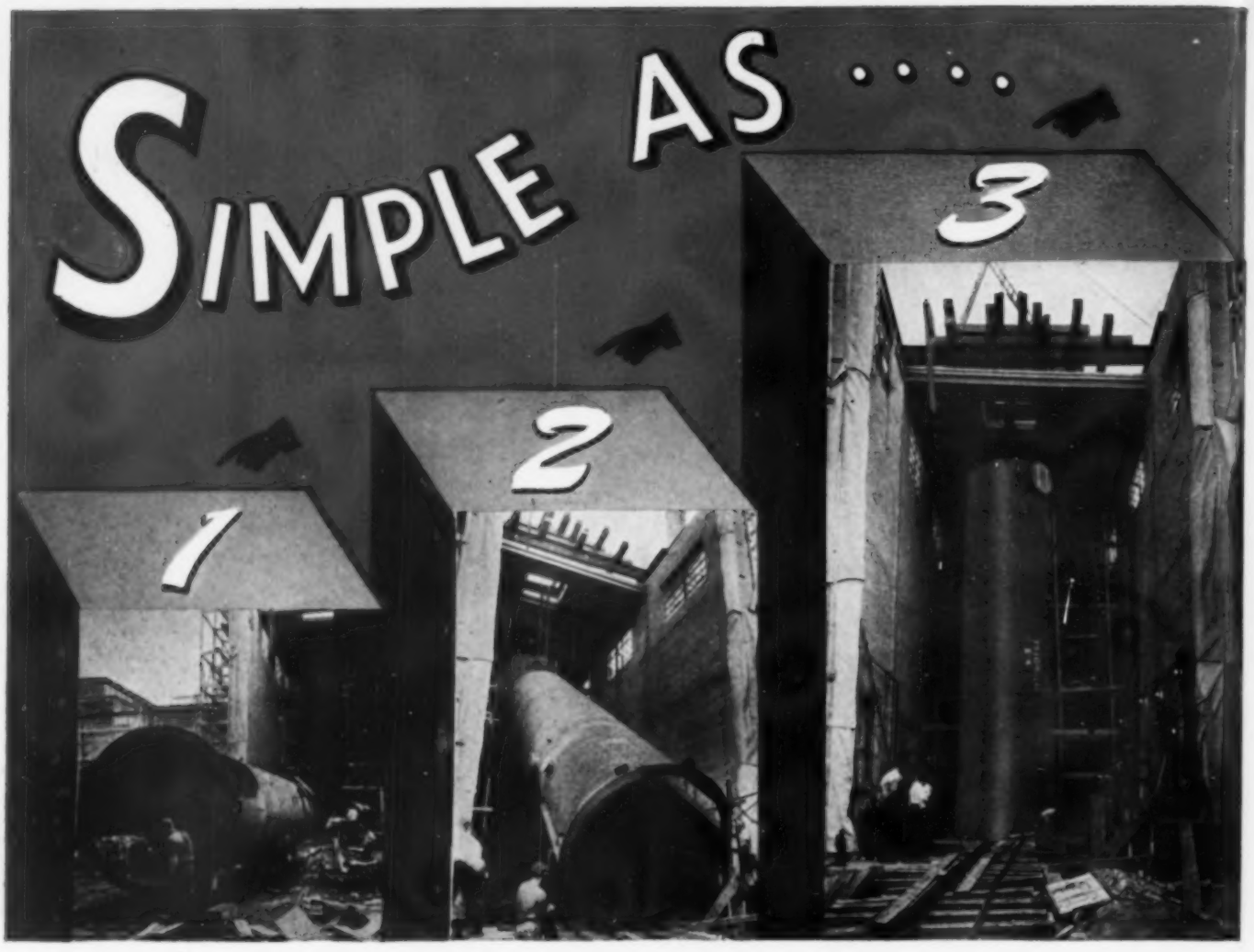

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- a – No structural supports required.
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2 – Operating Advantages –
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NEWS FROM ABROAD

Special Correspondence

McGRAW-HILL *World News*

Italy issues petroleum exploration permit . . . India pools fertilizer supply . . . New tin plate mill in Urals . . . Another atomic pile for Britain at Harwell.

Subsidiary of American Firm Gets Oil Rights in Italy

THE Societa Italo-Americana Per Ricerche Petrolifere, a subsidiary of Standard Oil Co. (New Jersey), has been granted permission by the Italian ministry for industry and commerce to carry on oil explorations over a 15,000 acre area in the Ferrara zone. The ministry has granted similar concessions to the Edison Electric Co. of Milan over a 10,000 acre section in Piacenza zone, and the Idrocarburi Nazionali of Florence over 10,000 acres in the Forli zone.

The Arabian American Oil Co. is reportedly exploring the possibilities with the Ministry of creating two refineries in Italy to process the crude oil from Saudi Arabia. The Italian government has agreed to make custom concessions if the deal goes through.

Tentative plans call for Arameco to set up an Italian subsidiary which, under the Italian flag, would operate tankers between Saudi Arabia and Italian ports.

India Pools Phosphate Fertilizer Supply

A GOVERNMENT-RUN phosphate fertilizer pool has been established in India along the lines of the currently operating government nitrogenous fertilizer pool.

Under the arrangement all domestic fertilizer and imports will be pooled and distributed through authorized dealers at fixed prices. Consumption will be held to 100,000 long tons of superphosphate fertilizer and bonemeal a year.

Between 25,000 and 30,000 long tons is being produced in India at present but output could be raised to 50,000—leaving at least 50,000 more to be imported. Since prices of imported superphosphate is well below Indian prices the government will handle the imports as a monopoly.

Prices will be averaged out between Indian and imported levels and the imported product distributed to provincial governments on a non-profit basis.

The program is slated to last for five years, by which time India hopes to have increased her production to near-demand levels.

Soviet Tin Plate Mill Operating in Urals

NEW Soviet tin plate mill erected in the Urals as a project of the current five-year-plan is now reported operating full blast, with shops extending over a mile and dominated by a tall boiler house.

The new tin plate mill is situated in Seversky, Sverdlovsk Oblast, on the site of an ancient metal smelting enterprise originally founded by Demidov, early eighteenth century father of the Ural copper and iron industry. An extensive workers residential area of multi-story apartment dwellings has been built to house plant employees.

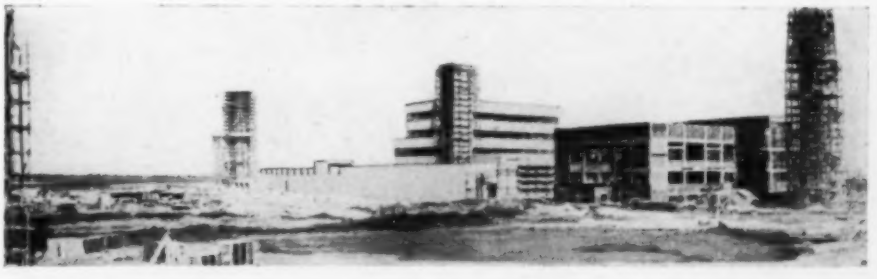
Earmarked for utilization in the canning factories of the nation's food industry, the tin plate output from the new mill is stated to be shipped to all parts of the USSR.

CHEMICALS were prominently displayed at the recent Milan Fair.

Britain's Second Atomic Pile Ready This Summer

BRITAIN'S large-scale atomic energy pile will be in operation this summer, the Ministry of Supply announced.

This is the second British pile to be set up by the Atomic Energy Establishment at Harwell, Berkshire. The big pile will produce enough radioactive isotopes to supply the needs of all the medical and other scientific research workers investigating peaceful uses of atomic energy in Great



RAYON and cellophane are produced at this unit of Societe Misr pour la Rayonne, S. A. E., at Kafr-el-Dawar, Egypt. The plant is shown under construction.

Britain. It will also provide the first domestic application of atomic energy —by providing the heat for all the buildings at the Harwell research station.

The second pile will be a big-brother to the "GLEEP" (Graphite Low Energy Experimental Pile) which was set going last year. Production of isotopes—which will have a much greater activity than those now produced in the GLEEP—will be stepped up considerably.

The GLEEP itself in March produced a record total of over 120 samples of chemicals transformed into radioactive forms by exposure in the pile. A third of these were used at Harwell; the rest went to hospitals and research laboratories all over the country. So far, isotopes of about 30 elements have been produced. The one prepared in the largest quantity has been radio-sodium, most of which has been used in hospitals for diagnostic purposes, particularly in vascular diseases. Other isotopes have gone to cancer research institutions, among others.

Products of the Harwell piles are to be packaged and distributed by the Government-controlled Radiochemical Centre at Amersham, Buckinghamshire. Considerable progress has been made at Harwell in designing safe packages for shipment of radioactive materials, so that if an accident befell in transit no radioactive substances would escape to cause possible damage.

Aluminum Research Center Planned at Arvida

PLANS for a new Canadian research laboratory at Arvida, Que., have been completed by Aluminum Laboratories, Ltd. Construction on the $1 million project will start soon. This will be the third laboratory operated by the subsidiary of Aluminum, Ltd. Others are at Kingston, Ont., and Banbury, England.

More Oil in French Pyrenees

IN MID-MAY oil was struck at a depth of 5,800 ft. near the village of Saint-Marcet in the Pyenees region of southern France. Yield is at a rate of about 25 tons daily.

This is the first positive result in an intensifying French search for oil in the Pyrenees region. Natural gas has been produced since 1940 at Saint-Narcet, with the current yield being 500,000 cu. m. daily, and it was known that oil lay under the same spot. The

A "PERMUTIT PROCESS"

SHORT-CUT!

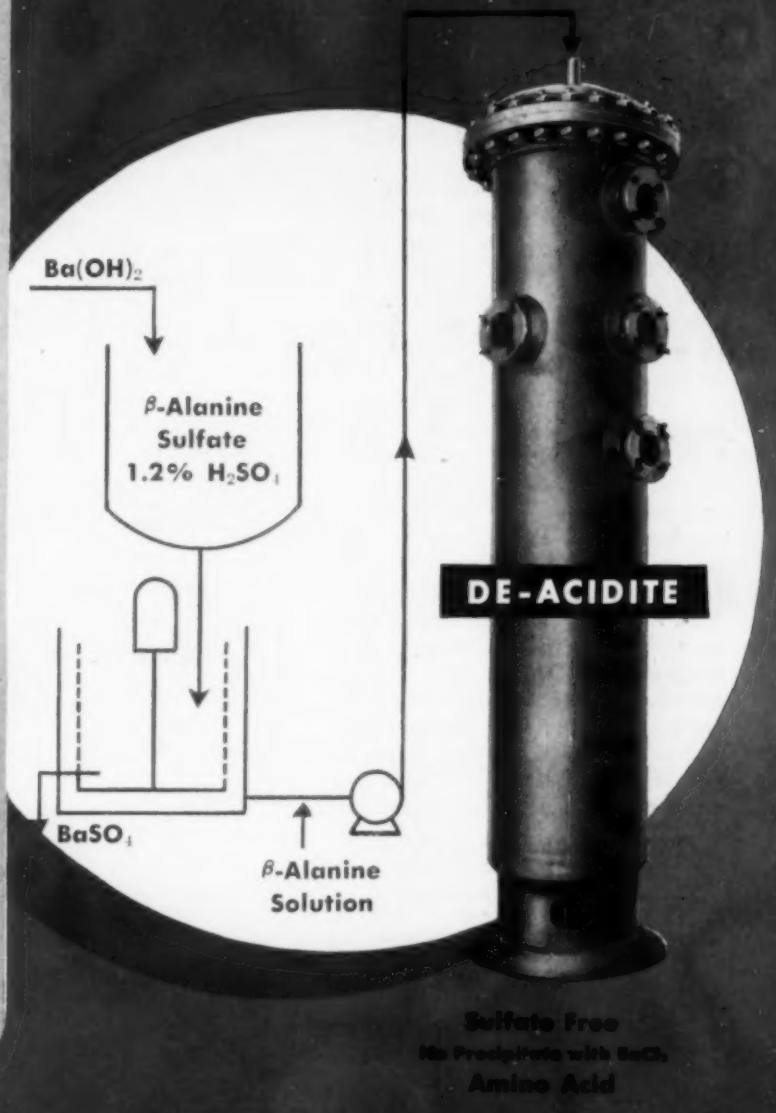
IT SAVES TIME
REDUCES COSTS
IMPROVES PRODUCT

. . . at a leading chemical company in New Jersey. As a major producer of β-Alanine and other fine chemicals, this chemical company has been using this Permutit process as a short-cut for removing residual sulfates from the crude solution of this amino acid. Here Permutit De-Acidite (anion exchange resin) separates the excess free and combined sulfuric acid from the β-Alanine solution.

No longer is it necessary to conduct tedious precipitations and difficult filtrations in this separation. Now one partial neutralization and centrifuging operation followed by a simple De-Acidite treatment to remove residual sulfates gives an improved product at much lower cost.

The Permutit De-Acidite process also eliminates the serious problem of evaporator foaming during concentration of the treated alanine solution which formerly required the constant attention of an operator.

For further details on this and other Permutit equipment, write to The Permutit Company, Dept. CE-7, 330 West 42nd Street, New York 18, New York, or to the Permutit Company of Canada, Ltd., Montreal.



Permutit

ION EXCHANGERS MATERIALS AND EQUIPMENT WATER CONDITIONING

oil stratum had been tapped in 1939, but owing to faulty technique the petroleum could not be brought up.

The French began drilling again early in 1947. But this time they took the precaution of bringing over a Standard of California drilling expert and a crew of Texas rig-men, who instructed the French drillers. They also acquired some new American deep-drilling equipment.

Twenty wells have been started in the current campaign to free France from dependence on foreign oil. Two have been abandoned but eighteen are still churning ahead. Average depth reached so far is 8,000 ft. though one has been pushed already to 13,200 ft. and another almost as far.

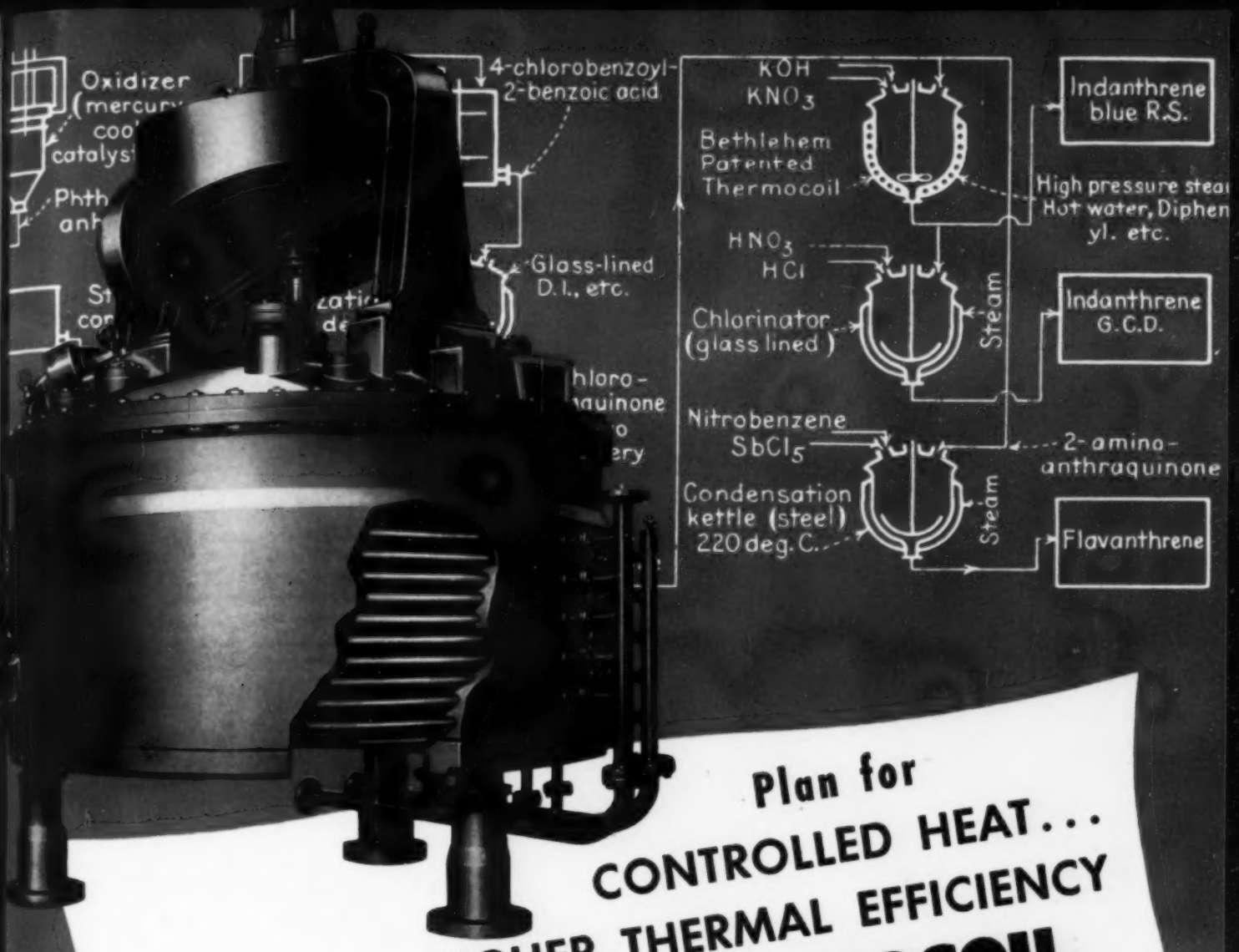
Three companies are now in the field. The Regie Autonome des Petroles, which has the Saint-Marcet development, is wholly government-owned. The Societe Nationale des Petroles d'Acquitaine and the Societe Nationale des Petroles de Languedoc-Mediterrannee are 55 percent government-owned.

American interests have shown some desire to get drilling options in southern France. Standard Francaise des Petroles, a refining and distributing company owned chiefly by New Jersey Standard, Atlantic and Gulf, applied last year for a large concession in the Gironde region north of the Pyrenees. This request has not yet been voted on by the National Assembly.

British Chemical Production Catching up With Demand

An easier tone is spreading through the British chemical markets. Retail stocks of pharmaceuticals and cosmetics have been raised to and above prewar levels, and in these as well as in other trades growing buyers' resistance has already led to some price concessions. In other sections of the chemical industry, however, demand shows no sign of abating. All types of chemicals are wanted in sterling countries and European markets, and Middle Eastern buyers are also reported to show preference for British products payable in sterling currency. However, demand is becoming more selective. Heavy basic chemicals, organic and inorganic, are still produced in insufficiently large tonnages to meet all demands, but many fine chemicals and manufactured items begin to reach the limits of their potential market, domestic and foreign.

Nevertheless plant extension programs are pushed ahead vigorously, and after a temporary suspension of



Plan for CONTROLLED HEAT... HIGHER THERMAL EFFICIENCY

BETHLEHEM THERMOCOIL

When quick temperatures at exact levels are desired . . . and controlled uniformity over the entire interior of the vessel . . . specify Bethlehem Thermocoil equipment.

Its patented construction utilizes a series of coils of steel tubing cast integral with the wall of the vessel. Through these tubes steam, hot water or other liquids under pressure are continuously circulated and provide more rapid rate of thermal transfer. Result? More even distribution of heat accurately controlled, higher thermal efficiency.

Bethlehem Thermocoil principle assures longer life and eliminates the fire hazard of direct firing on all processes involving the application of heat up to 660° F.

This exclusive Bethlehem equipment is so flexible in application that it is readily adaptable for use with one process or the other—thus eliminating the need of purchasing new equipment. For full details on how Bethlehem equipment can help you in your processing write, wire, or phone.

BETHLEHEM

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new building licenses due to the shortage of steel and saturation in the construction industries, it seems that the government is once again issuing authorizations for the erection of new chemical works. During May, official permits were issued for new plastics works, refractories plant, coke-oven batteries, and various extensions. Imperial Chemical Industries at last received permission to go ahead with their "Ardil" fiber scheme. A factory to employ approximately 500 workers is to be built in Dumfries, Scotland, during the next two years. ICI has also bought a site for a new nonferrous metals plant in Liverpool.

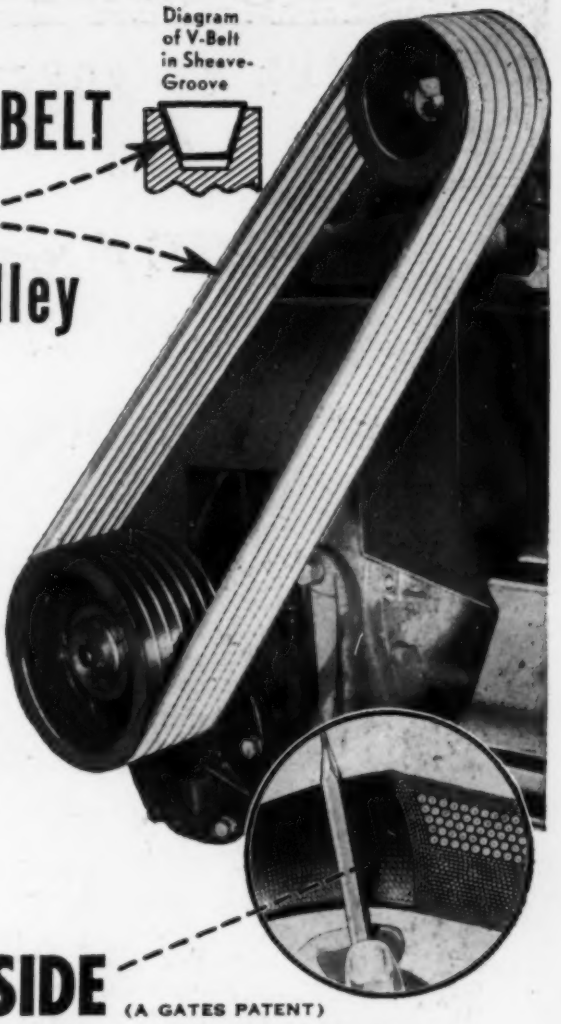
Most chemical firms with extension projects under development expect to make more progress with them this year than they did last year. Chemical plant and apparatus remains one of the worst bottlenecks in the way of industrial development. Delivery delays have resulted in a complete overhaul of extension schemes, often leading to the development of more ambitious and costly projects. Unfortunately revision of earlier expansion plans has in many cases further delayed their completion. The full effect of the extension of alkali capacity, for instance, will not be felt until next year although the need for its extension was foreseen, and prepared for, early in the war. The position is not greatly different with sulphuric acid, chemical fertilizers, coal-tar derivatives, or hydrocarbon products.

Higher Production

Since the end of the war a great deal has been done to put idle plant into operation and to make maximum use of existing capacities, with the result that, at the cost of considerable administrative and operational inconvenience, record outputs are now being achieved. The leading chemical producer in the country reports for 1947 (when production was temporarily slowed down by the hard winter and lack of fuel) that, with the important exception of alkali, production of its major products was higher than in 1946, and in the case of blasting explosives, non-ferrous metals, industrial nitrocellulose and certain fertilizers a new record was established. This year output of all products will increase beyond the 10 percent by which the government wants to raise British industrial production as a whole this year.

While 100 percent use of plant capacity naturally tends to reduce depreciation and obsolescence rates per unit of production, neglect of regular repairs and reliance on out-of-date plant has added to the production costs of chemical manufacturers in

The SIDE of a V-BELT is what GRIPS the pulley



Naturally, it GETS the WEAR!

Any one familiar with V-Belt drives knows that the sides of a V-Belt are what really get the wear.

It's the *sides* that grip the pulley. They *pick up* all the power from the driver pulley, *transmit* that power to the belt as a whole and then, once more, they *deliver* the power to the driven pulley. And, clearly, it's the *sides*—and *only* the sides—that take the wear against the sheave-groove wall.

That is why you have always noticed that the *sidewall* of the *ordinary* V-Belt is the part that *wears out first*—and, naturally, if you prolong the life of the sidewall, you *lengthen* the *life* of the *belt!*

Now See How the CONCAVE SIDE (A GATES PATENT) SAVES Sidewall Wear and Lengthens Belt Life!

Straight Sided V-Belt

How Straight Sided V-Belt Bulges When Bending Around Its Pulley

You can actually feel the bulging of a straight-sided V-Belt by holding the sides between your finger and thumb and then bending the belt. Naturally, this bulging produces excessive wear along the middle of the sidewall as indicated by arrows.

Gates V-Belt with Patented Concave Sidewall

Showing How Concave Side of Gates V-Belt Straightens to Make Perfect Fit in Sheave Groove When Belt Is Bending Over Pulley

No Bulging against the sides of the sheave groove means that sidewall wear is evenly distributed over the full width of the sidewall—and that means much longer life for the belt!

The simple diagrams on the left show exactly why the ordinary, straight-sided V-Belt gets excessive wear along the *middle* of the sides. The diagrams show also why the Patented Concave Side greatly *lengthens the life* of the *sidewalls* of Gates Vulco Ropes. That is the simple reason why your Gates Vulco Ropes are giving you so much longer service than any straight-sided V-Belt can possibly give.

Saving SIDEWALL WEAR is more important NOW than ever before. ..

Now that Gates *SPECIALIZED* Research has resulted in Super Vulco Ropes capable of carrying much heavier loads—fully 40% higher horsepower ratings—the sidewall of the belt is called upon to do even more work in transmitting these heavier loads to the pulley. Naturally, with heavier loading on the sidewall, the life-prolonging Concave Side is more important now than ever before!

Gates

THE MARK OF SPECIALIZED RESEARCH

THE GATES RUBBER COMPANY *Denver, U. S. A.*

"The World's Largest Makers of V-Belts"

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GATES VULCO ROPE DRIVES

Engineering Offices and Jobber Stocks IN ALL INDUSTRIAL CENTERS of the U. S. and 71 Foreign Countries

general. Many of them have used their big profits last year to make special provision for the financial cost of plant obsolescence and replacement, but even so it is doubtful whether care has yet been taken of the financial problems certain to arise in the near future. At the present high rates of taxation industrial producers cannot hope to finance plant replacement, modernization and extension out of the reserves accumulated from current profits. The high cost of new plant and the large sums of money needed for replenishing stocks have already made heavy inroads in reserves accumulated over a number of years, and huge sums will be needed to meet the cost of current expansion schemes.

New Stock Issues

Many chemical firms have therefore sought finance from outside sources to carry out expansion plans. Imperial Chemical Industries hope to obtain between £20,000,000 and £25,000,000 of fresh finance by the issue of new shares to existing shareholders, and smaller companies have approached the public finance markets for substantial sums. These issues however cover only part of the cost of new production schemes, and it is possible that official assistance will be required to meet the financial requirements of the British chemical industry. One new firm, Petrochemicals Ltd., which is building a big plant for the manufacture of chemicals from petroleum by the Catarole process, will obtain nearly £1,500,000 of new finance from one of the government's finance institutions for industry, and other firms may have to draw on the same source for at least part of their capital. Through ownership of the nationalized coal and gas industries and of explosives and ammunitions factories, the government already holds a definite interest in certain sections of the chemical industry. Financial assistance for the application of new processes by government-sponsored finance institutions is likely to increase official interest in chemical enterprise.

Long Term Plans

Present production difficulties have caused leading British companies to shift the accent in research from current manufacturing problems to fundamental long-term investigations. Thus ICI workers are now studying the potentialities of a number of new physical techniques developed during the war years, such as the application of the electron microscope to the study of small particles and surface phenomena, of the infrared spectrometer to

chemical analysis, and of artificial radioactive elements to chemical and biological problems. Great attention is also devoted to the science of electronics in connection with the design of instruments for regulating and controlling manufacturing operations. The company is working on plastic optical components, new synthetic fibers and therapeutic substances.

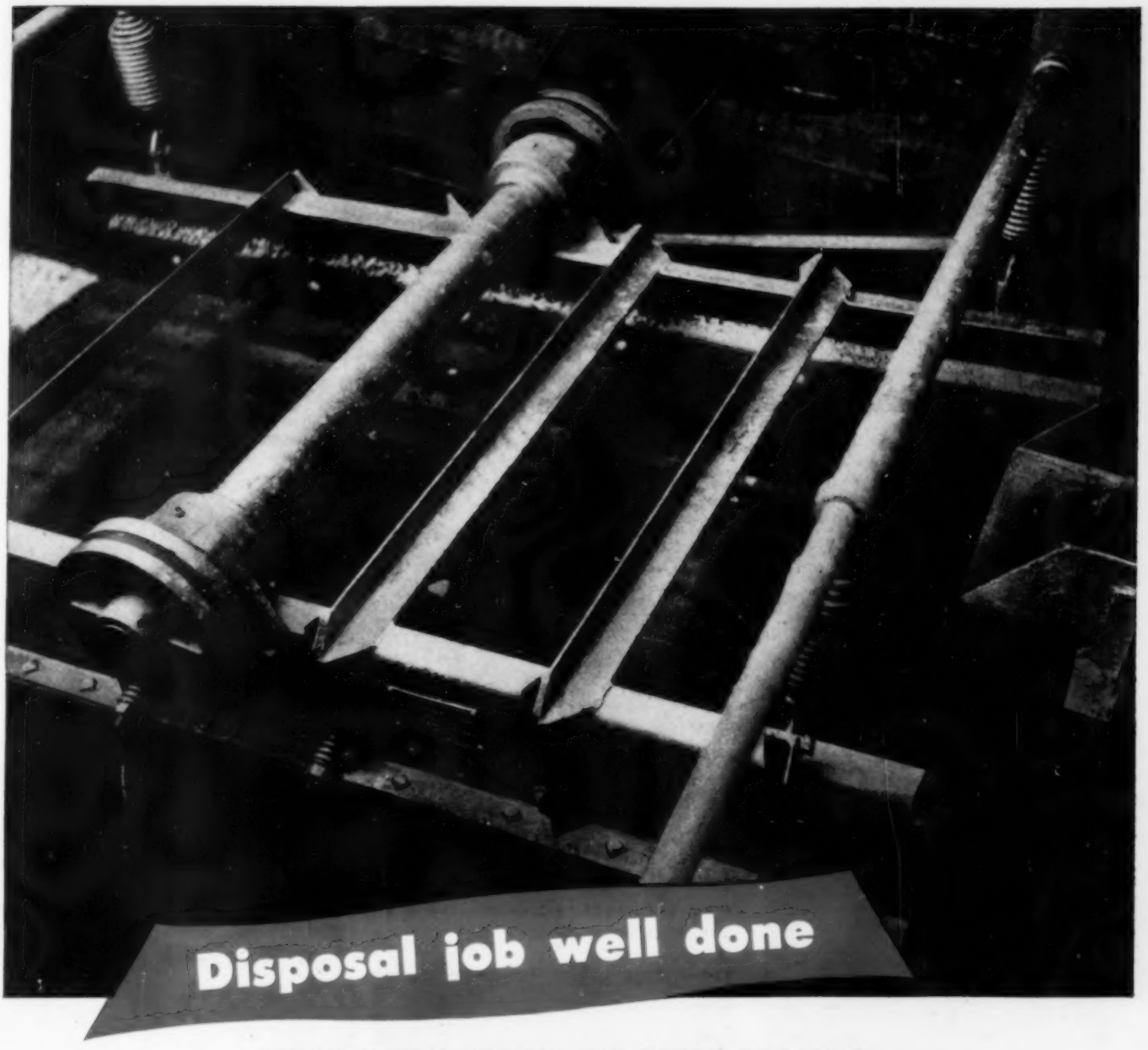
The Shell group has officially opened its research center at Thornton-le-Moors, claimed to be the largest and most modern chemical-oil research station in the British Commonwealth. In the main chemcal laboratory the principal subject of research is the production of paints and varnishes from petroleum bases with a view to their substitution for linseed oil, and work is also going on in connection with lubricating oil additives, synthetic detergents, and plasticizers for the rubber industry.

The encouragement of exports by priority supplies of scarce raw materials and other means has led to a continuous increase in shipments of chemical products for three months running. At nearly £7,000,000 (in April) British chemical exports are well on the way to the export target for the end of 1948 of just over £8,000,000. The principal markets for British chemicals are in the sterling area. Australia, India, Pakistan, South Africa and Eire are absorbing steadily growing quantities of British chemicals, and the Scandinavian States and the Middle East also provide useful outlets. On the other hand, considerable difficulty is experienced by British makers in supplying the types and grades of chemicals required in the Western hemisphere, and the price factor is said to be making itself felt again in countries where currency considerations do not matter. In the import trade, efforts to obtain raw materials for chemical manufacture from soft currency countries have not been very successful, to judge from the latest official statistics. The bulk of imported chemicals still comes from North America and is likely to continue to do so.

India Plans Alcohol Output to Ease Gasoline Shortage

DEVELOPMENT of a large-scale Indian power alcohol industry in an effort to make up for the country's great deficiency in gasoline has been approved by the Central Assembly in a bill which gives the government the right to regulate the manufacture, distribution and admixture.

The measure is based on the thesis



ROBINS HYDREX SCREENS LICK STREAM POLLUTION PROBLEM FOR CANNERIES

Cannery men, among others, have discovered that you can separate solids from liquids quickly and easily with Robins Hydrex Screens.

In order to avoid stream pollution they simply hose peelings, rind and other waste down through floor troughs that lead to Robins Hydrex Screens. These proved vibrating screens then process the fluid, creating a clear effluent and sending the solids to a disposal chute or belt.

Of course, your job of separating solids and liquids may be different from this example. But you'll find you can do it better with Robins Hydrex Screens. You can use them to

1. Save liquids from solids
2. Save solids from liquids
3. Remove fines from coarser materials

Furthermore, Robins Hydrex Screens assure you of continuous operation. That's because the high-speed vibrations of these screens produce a self-cleaning, self-discharging action.

You can get Robins Hydrex Screens in floor-mounted or suspended types, and in models to handle hot or cold materials, acid or alkaline.

Why not investigate Hydrex Screens for *your* work? Write Robins *today!*

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HYDREX SCREENS

SEND TODAY for an analysis of your particular screening problem and details about how it can be solved with Robins Hydrex Screens. Address Robins Conveyors Division, 270 Passaic Avenue, Passaic, New Jersey.

ROBINS CONVEYORS DIVISION **HEWITT-ROBINS INCORPORATED**

that mixture of gasoline with alcohol should be compulsory. It sets the mixture at between 5 and 25 percent of alcohol by volume, leaving the decision to the government as to when and where mixture is to be required.

Origin of the law is a 1947 report by a special government panel which pointed out that although India currently produces about 400,000 long tons of molasses as a sugar industry by-product more than 250,000 long tons are thrown away. When a sugar industry expansion program now under way is completed total molasses production will reach 500,000 long tons.

The panel recommended that 20 new distilleries should be set up to augment the five existing alcohol units now producing about a million gallons annually compared with a capacity of about 2,500,000 gal. Each of the new units would have an annual capacity of a million gallons.

This would give a combined production of more than 20,000,000 gal. of alcohol which could be mixed with gasoline. Its importance to the country is seen in the fact that a saving of an equivalent volume of gasoline which has a landed cost of roughly 13c. per gal. could be effected. Cost of production of the alcohol is estimated at 12-14 c. per gal. But the domestic production would increase the country's wealth.

Alternately it would permit a loosening of the extremely tight rationing of gasoline. Indian annual consumption of gasoline now is at the rate of about 150,000,000 gal. (compared with 100,000,000 gal. prewar) of which only some 10 percent is produced within the country.

When the government begins implementation of the new law it will mean big business for foreign equipment suppliers as well. Estimates are that each of the 20 proposed distilleries would cost $300,000 of which $100,000 would be in foreign equipment—total $2,000,000.

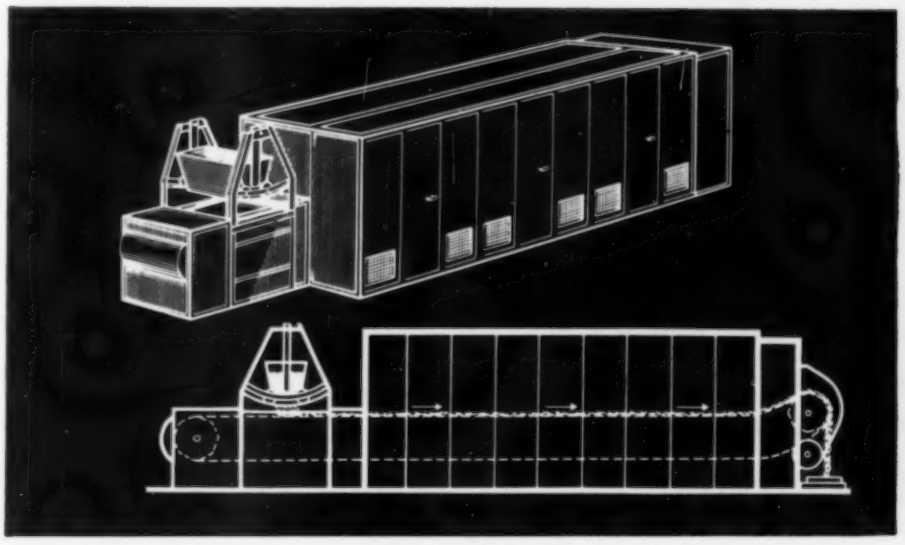
Travancore Pigment Plant Under Construction

Travancore Titanium Products Ltd., organized last year to produce titanium pigments from the South Indian state's mineral sands, will not be in production before 1951. That is the verdict of the firm's directors after reviewing the problems which have beset the company so far.

Main problem has been the siting of the factory. A location near Trivandrum was chosen because of accessibility to the deposits but water supply proved poor. Well-boring machinery was ordered from North India but the civilian disturbances and the

PUBLISHED MONTHLY FOR PROCESS INDUSTRIES EXECUTIVES AND OPERATING PERSONNEL

NARROW CONVEYOR DRYER PROVES IDEAL FOR LOW PRODUCTION, HIGH VALUE PRODUCTS



The development of a Proctor continuous dryer with a 2′ wide conveyor has opened up an entirely new approach to the processing of many low production, high value products.

OUTMODES BATCH DRYING FOR SOME PRODUCTS

Until now, many products which seemed otherwise suited to continuous processing could not be handled in continuous systems because of output limitations. Often output requirements were far too low to make continuous operation feasible. Continuous drying systems have always been geared to output in tons per hour—whereas these products are produced in pounds per hour. Consequently these products have always been handled in batch systems and have been denied the advantages of continuous operation. This narrow conveyor drying system now makes possible all of the advantages of continuous conveyor drying—for products of high value—but low production. This system which is patterned after the huge continuous systems designed by Proctor & Schwartz—incorporates all of the advantages of the large machines from standpoint of quality control. Because of the rapid drying possible with preforming and continuous conveyor drying—it is possible to take advantage of high temperatures and to capitalize on flexibility of temperatures that can be obtained in continuous drying. Certain features of design of these narrow conveyor dryers make possible the handling of heat sensitive and corrosive products without the danger of contamination. Research into the physical characteristics and output requirements of your individual products will reveal how well this new narrow conveyor continuous system will meet your individual requirements.

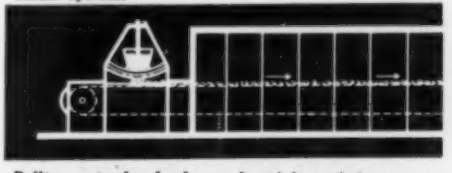
SUITABLE FOR PILOT PLANT

Another use to which some of these narrow conveyor systems have already been put is pilot plant operation for continuous processing. Representing an investment commensurate with pilot plant requirements—this application makes it entirely possible for the operator to observe continuous drying in actual operation—at pilot plant scale of output.

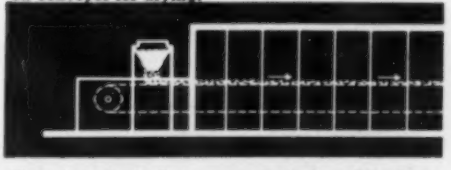
CAN BE COMBINED WITH ANY PREFORMING FEED

Any Proctor preforming feeding device can be engineered to dovetail with this low-output system—thus bringing all the advantages of preforming and continuous conveyor drying to the low-output product for the first time.

Fin drum feed, where product must be partially dried in order to hold a definite shape to be suited to conveyor drying—can be coupled easily with this small system.



Rolling extruder feed—used widely with large continuous systems—can be readily scaled to precede the narrow conveyor dryer. By means of this feed—product is formed into small extrusions and deposited on conveyor for drying.



Granulator feed—for comparatively dry solids whereby product is formed, through a screen, into relatively uniform granules. Ideally suited to lumpy or granular materials as well as hard framed press cake.

snarled railways delayed delivery for six months. In addition shortages of construction materials have seriously handicapped progress.

British Titan Products Ltd. is the parent concern of the Travancore company's managing agency and is supplying technical assistance in development of the works.

India and Pakistan Sign Trade Agreement

CHEMICAL raw materials play an important part in a trade agreement recently negotiated between the Dominions of India and Pakistan. The agreement is not a formal trade treaty, but instead sets up volumes of certain commodities which shall be handled between the two countries by private channels during the next 12 months.

India is to get from Pakistan 78,000 long tons of rock salt annually, 5,000 long tons of potassium nitrate, 5,000 long tons of soda ash. Among the items she is to give Pakistan are 160,000 long tons of coal a month, 7,500 long tons of paper and 20,000 long tons of iron and steel.

Barium Chloride Process Developed in Bombay

A PROCESS for barium chloride production has been developed at Bombay University's Department of Chemical Techonology. The method involves roasting barytes with wood charcoal, powdering the mass and heating the pulverized material with 46-47 percent magensium chloride solution while stirring. The process yields low cost barium chloride which is suitable for removal of sulphate impurities in brine. Sulphur is obtained as a byproduct. Commercial possibilities are being investigated on a pilot plant scale.

India May Build Another Alkali Plant

POSSIBILITIES of establishing a salt-caustic soda-soda ash industry in Mandi state in the northern Punjab are under examination. The project is especially important since the splitting off of Pakistan from India gave the new dominion in the immense salt deposits at Khewra and cut northern India off from this main source of supply.

The Mandi state deposits, according to preliminary surveys, run for about 40 miles and are up to a quarter-mile wide and 100 ft. thick. Purity is only about 75-80 percent due to such in-

soluble matter as quartzite, sandstone and lime, and a heavy overburden of limestone and traprock covers the body.

The deposits are within a few miles of the 48,000 kw. Jogindernagar hydroelectric station and water is available to permit hydraulic mining via the brine method.

Surveys indicate a 100-ton a day salt plant could produce at a cost of about $11 a long ton, a 100-ton a day soda ash plant at about $20 a long ton, and a 10-ton a day caustic soda plant at about $45 a long ton.

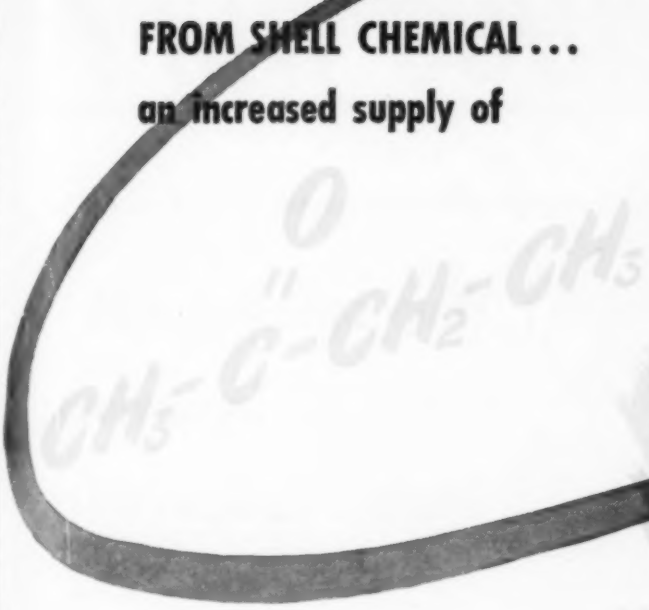
Seaweed Fabric Displayed At Edinburgh

STRIPS of greenish fabric, made from seaweed, were only one of many derivatives on display at the first exhibition of the Scottish Seaweed Research Association opened here recently.

Sir Stephen Bilsland, chairman of the Scottish Council (Development and Industry), opening the exhibition, said that besides the fabric, seaweed could be turned into plastics, transparent paper, cosmetics, films, ice-cream, salad creams, custard, jams, sauces, jellies, sugar substitute (for diabetics), baby foods, printing and marking inks, animal and poultry foods and fertilizers.

FROM SHELL CHEMICAL...
an increased supply of

Methyl Ethyl Ketone



To help meet the needs of industry, Shell Chemical has recently placed "on-stream" at Houston, Texas, its third MEK plant. With this phase of its postwar expansion completed, one more important step has been taken toward providing industry with adequate supplies of high quality organic chemical products.

MEK has been found to be outstanding as an active solvent for nitrocellulose lacquers, as well as for fabric and surface coatings based on the various vinyl resins. It is also successfully used in the manufacture of adhesives and cements which utilize Buna-N and neoprene rubber.

Other important products in which MEK finds application are can coatings, paint and varnish removers, rubber chemicals and printing inks.

LACQUER SOLVENT PROPERTIES

Dilution Ratio	
Toluene	4.4
Aromatic Petroleum Naphtha	1.4
Aliphatic Petroleum Naphtha	0.9
Viscosity (8% RS ½ second Nitrocellulose solution at 25°C)	10 centipoises
Blush resistance (% relative humidity at 80°F)	45%
Rate of evaporation (normal butyl acetate = 1.0)	4.6

A letterhead request to any of the Shell Chemical offices listed below will bring you technical literature and a sample.

Among the many other Shell Chemical products are Methyl Isobutyl Ketone, Methyl Isobutyl Carbinol and Tertiary Butyl Alcohol

SHELL CHEMICAL CORPORATION

100 Bush Street, San Francisco 6 • 500 Fifth Avenue, New York 18
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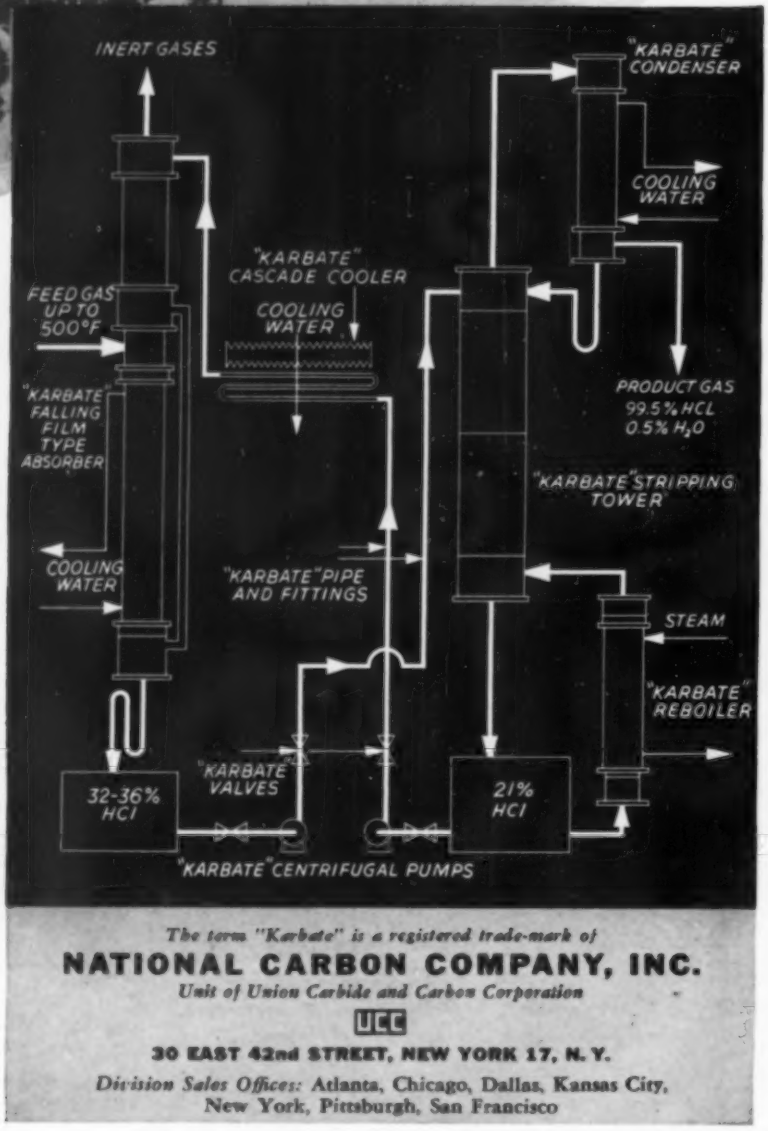
MAKE ANHYDROUS HCl?

Whip corrosion with "KARBATE" Impervious Graphite Equipment!



A typical flow sheet of one system for producing anhydrous HCl from feed gases up to 500 deg. F. containing inert gases.

IF YOU manufacture anhydrous HCl for use in the production of plastics, alkyl chlorides, synthetic rubber, or other materials, you can eliminate corrosion permanently by using "Karbate" Impervious Graphite corrosion-resistant equipment. The *entire* system can be assembled of *standard* "Karbate" units, including acid absorbers, cascade coolers, towers, heat exchangers, pipe, valves, condensers, pumps, tanks, and fittings. This equipment has the following advantages:

1. **Chemically inert to all concentrations of HCl**
2. **Very high heat-transfer rate**
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THE CORROSION FORUM

Edmond C. Feller, ASSISTANT EDITOR

Sulphuric Acid versus Construction Materials

Part III of a symposium in which typical materials of construction are evaluated for services involving sulphuric acid.

High-silicon iron pump with 21 yr. continuous service circulating 35–40 percent H_2SO_4 through SO_2 cooling towers.

HIGH-SILICON IRONS

WALTER A. LUCE
The Duriron Co.
Dayton, Ohio

HIGH-SILICON iron has been used for many years in applications involving sulphuric acid. This alloy exhibits excellent resistance to all concentrations of the pure acid up to and including boiling temperatures.

Duriron is a high-silicon iron with a nominal chemical composition of 14.5 percent Si, 0.75 Mn, and 0.90 C max. It is available in the cast form only and any required machining usually is done by grinding. A limitation of the high-silicon irons is their susceptibility to thermal or mechanical shock. However, if reasonable care is exercised by maintenance men, long life can be expected; many applications involving rigorous thermal conditions can attest this fact. A variety of equipment is made with Duriron, such as pumps, valves, heat exchangers, heaters, jets, fans, ejectors, kettles, nozzles, tanks, pipes and tower sections.

Applications in the chamber process are numerous, and involve pumps on Glover and Guy-Lussac towers, Glover tower outlets, valves of various types, pipe, and numerous other parts throughout the plant. Although lead equipment is extensively used in this process, high temperatures call for Duriron. Only a limited amount of Duriron is used in the contact process where sulphuric acid concentrations of 66 deg. Be. at relatively lower temperatures favor the use of iron or steel.

Fertilizer plants are also extensive users of Duriron equipment. Many of these plants manufacture their own sulphuric acid by the chamber process, hence have Duriron requirements as noted above. Sulphuric acid used in the manufacture of fertilizer is usually diluted from 60 or 66 deg. Be. to 50 Be. where temperatures often reach 250-300 deg. F. Duriron pumps and valves are used to handle this hot acid prior to mixing with desired chemicals. When the fertilizer plants do not manufacture their own acid, Duriron pumps and valves are extensively used in pumping the acid from tank cars to the plant prior to dilution.

The concentration of sulphuric acid also involves much equipment made from high-silicon iron. Duriron sleeves, tubes, and Y-valves are used in the Mantius type concentrator; while pipes, fittings and tank outlets are used in the Chemico type concentrators. Duriron tubes and liners are used in the falling film type concentrators. Pumps and valves of Duriron also are used before and after these concentrators to circulate the acid.

Additional typical applications are: (1) Duriron has given long, satisfactory service in the manufacture of alum which involves digesting bauxite ore with sulphuric acid. Pumps and valves handling 34 percent sulphuric acid at a temperature somewhat over 200 deg. F. have now been in service over four years and are still giving excellent service. Duriron pumps are almost standard for paper mills handling alum solutions containing free sulphuric acid and for straight sulphuric acid. (2) Over five years service is being given by Duriron pumps and valves for handling an extremely corrosive slurry consisting of sand, beryllium sulphate and sulphuric acid near the boiling point. This solution is difficult to handle because of abrasion and the high temperature. Manganese ore is similarly digested to give another erosive slurry containing manganese sulphate, sand, and sulphuric acid at a high temperature. (3) Very satisfactory results are obtained using Duriron equipment in steel mills. The solutions may vary in concentration from 6-10 percent at 180 deg. F. in batch picklers and from 25-30 percent at 220-230 deg. F. in continuous picklers. Duriron pumps and valves are also being used to circulate sulphuric acid countercurrent to the strip in semi-continuous strip picklers. (4)

Duriron heat exchangers, flanged pipe and fittings are used in many installations which require 70-77 percent sulphuric acid to be cooled from a maximum temperature of 350 deg. F. to approximately 100 deg. F. Duriron pumps and valves are also used to handle all concentrations of sulphuric acid in the manufacture of storage batteries in the automotive trade. (5) Installations such as those cited above have been made in brass mills, by-product coke works, synthetic rubber plants, leather companies and many additional chemical companies using sulphuric acid. The accompanying photograph is illustrative of a typical Duriron installation of this type.

Relatively few contaminants seriously alter the excellent corrosion resistance of the high-silicon irons to sulphuric acid. Generally if Duriron will resist these foreign constituents in the pure form, it will resist them in sulphuric acid mixtures. Notable corrosives which attack Duriron are fluorine, hydrofluoric acid, other flurorides, sulphurous acid and a few others.

Durichlor is a special high-silicon iron containing an additional 3 percent Mo which imparts additional resistance to hydrochloric acid, chlorine, and most chlorides. No advantage is obtained in sulphuric acid service by using Durichlor, except when the above constituents are present as contaminants.

SILICONES

J. A. McHARD
Dow Corning Corp.
Midland, Mich.

TYPICAL samples of several commercially available silicone products were tested according to A.S.T.M. D 543-43 to determine their resistance to 10 percent, 30 percent, and concentrated sulphuric acid at room temperature and at 100 deg. C. Changes in viscosity were taken as a measure of the resistance of silicone fluids to various concentrations of sulphuric acid. On the basis of these laboratory tests it appears that silicone products, with the exception of certain silicone rubber stocks, have good resistance to dilute sulphuric acid at room temperature and at 100 deg. C., and poor resistance to concentrated sulphuric acid. A more detailed report on the effects of sulphuric acid on various silicone products is given in the following paragraphs.

Silicone Fluids—Data on the behavior of five different types of silicone fluids after seven days of exposure to 10 percent, 30 percent and concentrated sulphuric acid at room temperature and at 100 deg. C. are given in Table I. All of the various

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1. **Describes Durco corrosion-resisting alloys — Duriron, Durichlor, Durimet, Chlorimet, and Durco D-10,** stating composition, physical and mechanical characteristics, and names the corrosives for which each alloy is recommended.

2. Describes **Durco equipment** made of above alloys, as well as of **Monel, Pure Nickel, Inconel, Ni-Resist and Nickel Cast Iron.**

3. States **features** of each type of equipment, also **sizes, capacities** and the **alloys** in which it is available.

THE DURIRON CO., INC., DAYTON 1, OHIO

Branch Offices in Principal Cities

DURCO Adv. 53-GM

Table I—Resistance of Silicone Fluids to Sulphuric Acid

Fluid	Acid, Conc., Temp.	Viscosity Increase, %	Evaluation*
DC 200	10%, room	2.4	Good
	30%, room	1.6	Good
	Conc., room	Gelled	Poor
	10%, 100° C	3.4	Good
	30%, 100° C	7.0	Good
	Conc., 100° C	Gelled	Poor
DC 500	10%, room	3.6	Good
	30%, room	1.9	Good
	Conc., room	Gelled	Poor
	10%, 100° C	0.0	Good
	30%, 100° C	2.0	Good
	Conc., 100° C	Gelled	Poor
DC 550	10%, room	−13.9	Fair
	30%, room	−14.0	Fair
	Conc. room	Decomposed	Poor
	10%, 100° C	−10.5	Fair
	30%, 100° C	19.4	Poor
	Conc., 100° C	Decomposed	Poor
DC 701	10%, room	2.9	Good
	30%, room	1.9	Good
	Conc., room	Decomposed	Poor
	10%, 100° C	3.8	Good
	30%, 100° C	3.8	Good
	Conc., 100° C	Decomposed	Poor
DC 703	10%, room	−7.8	Good
	30%, room	−7.5	Good
	Conc., room	Decomposed	Poor
	10%, 100° C	−7.1	Good
	30%, 100° C	−7.1	Good
	Conc., 100° C	Decomposed	Poor

* Ratings are based on observation of the test sample as well as on measurable changes in viscosity.

types of silicone fluids tested, with the exception of DC 550, showed little change in viscosity and are rated as stable to 10 percent and 30 percent acid at room temperature and 100 deg. C. The DC 550 type fluid showed larger change in viscosity but still remained fluid and usable after exposure to dilute sulphuric acid. All of the silicone fluids tested were either gelled or decomposed by concentrated acid.

Silicone Greases—Two silicone lubricants, DC Valve Seals A and B, are designed for use in pressure lubricated valves and flow meter bearings where chemical resistance is most important. Laboratory tests and field experience indicate that both are serviceable lubricants in valves handling 10 and 30 percent sulphuric acid. Successful use of DC Valve Seal A in valves handling 98 percent sulphuric acid at room temperature has been reported by a large chemical plant.

Silicone Resins—Typical samples of

Table II—Resistance of Silicone Resins to Sulphuric Acid

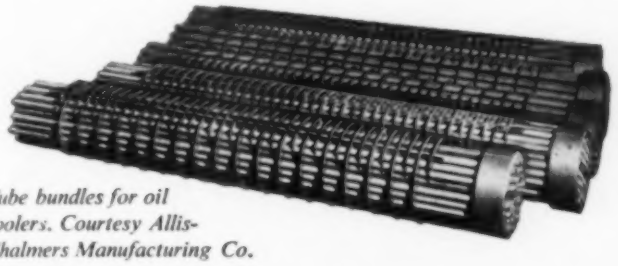
Resin	Acid Conc., Temp.	Wt. Increase, %	Evaluation*
DC 993	10%, room	0.00	Good
	30%, room	0.00	Good
	Conc., room	Softened	Poor
	10%, 100° C	0.00	Good
	30%, 100° C	0.00	Good
	Conc., 100° C	——	Poor
DC 996	10%, room	0.00	Good
	30%, room	0.00	Good
	Conc., room	Embrittled	Poor
	10%, 100° C	0.01	Good
	30%, 100° C	0.01	Good
	Conc., 100° C	——	Poor
DC 2103 laminated glass cloth	10%, room	0.00	Good
	30%, room	0.00	Good
	Conc., room	17.18	Fair
	10%, 100° C	0.00	Good
	30%, 100° C	0.00	Good
	Conc., 100° C	20.40	Poor

* Ratings are based on observation of the test sample as well as on changes in weight.

Importance of Protective Film

An important factor in the life of tubing handling various types of circulating water in petroleum refining, petro-chemical and chemical production is the protective film formed on the water side.

The corrosion rates of various metals and alloys are due largely to the character of the corrosion films formed and the speed with which they are re-established if damaged. Because the most highly protective films are often thin and invisible, their presence and importance is not generally recognized.



Tube bundles for oil coolers. Courtesy Allis-Chalmers Manufacturing Co.

Effect of Temperature and Water Composition — Temperature affects the reactions associated with film formation, and may affect water composition by increasing bacterial activity. Increased bacterial activity helps develop such gases as methane, ammonia, carbon dioxide and hydrogen sulphide in the water, which may injure some protective films and strengthen others. In some cases new tubing installed during the winter has given longer service than tubing installed during the summer because a more protective film has had an opportunity to form at the lower temperature.

Film formation varies with the type of water. Copper in Lake Erie water developed a thin, varnish-like protective film. On the other hand, copper exposed to water from certain wells and streams (in contact with calcium-rich mineral deposits) became covered with white to grayish-white or reddish-colored calcium carbonate scale, highly protective to copper.

Copper exposed to sea water develops a green-colored film bonded to a red-colored film attached to the copper. If the sea water contains a trace (0.5 or more parts per million) of hydrogen sulphide resulting from decomposition of organic matter, a marked increase in film thickness and in corrosion rate results. Copper galvanically coupled with a less noble metal such as iron, steel, aluminum, magnesium, zinc, etc., under certain conditions will form highly protective calcium-magnesium carbonate scales, often objectionable because of low heat transfer properties.

Preserving Protective Film—The protective film can be injured through abrasion from the sharp edges of sand, cinders, shells and other debris. Intake pipes should be kept clean and screens used to prevent the entrance of foreign matter. Tubes can be kept clean by rubber plugs, bristle brushes, high pressure water or air. Since scratches, dents and surfaces under porous deposits are among the points susceptible to attack it is desirable to maintain clean, smooth, undamaged metal surfaces. Chlorination and other procedures may be used to combat deposits of marine growth and slime.

Since the protective film may also be penetrated by impinging streams of water with or without air bubbles, turbulence should be reduced wherever possible and all connections checked to be sure that air is not entering the system.

Choosing the Correct Alloy — Alloy composition plays an important part in the formation of protective film. For example, the protective film formed on Aluminum Brass is repaired more readily than that formed on Admiralty. Tests conducted in various locations show how widely corrosion rates vary with the type of alloy, water composition and operating conditions. While no consistent rule can be laid down to correlate formation of protective film with corrosion rate, certain trends have been detected. For example, as the film thickness increases (in various waters) on Copper, Admiralty and Duronze IV (aluminum bronze), the trend is toward higher corrosion rates. When thin, protective films are present (less than 200 milligrams per square decimeter), low corrosion rates are encountered.

Since the average field or service corrosion test requires a period of from one to five years, it is advisable to anticipate tube requirements. Bridgeport's Corrosion Laboratory will be glad to co-operate with you in furnishing samples and conducting tests under actual operating conditions to aid in selection of the most suitable tubing alloy. Contact the nearest Bridgeport office.

The outstanding characteristics of the various condenser and heat exchanger tube alloys are described in Bridgeport's 120-page Condenser Tube Manual, which also contains suggestions for increasing tube life; corrosion data; methods of installing; specifications; etc. Write for your copy.

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CONDENSER AND HEAT EXCHANGER TUBING

Table III—Resistance of Silastic to Sulphuric Acid

Silastic Stock	Acid Conc., Temp.	Vol. Increase, %	Wt. Increase, %	Hardness[1] Before Exposure	Hardness[1] After Exposure	Hardness[1] After Reconditioning[3]	Elasticity[2] Before Exposure	Elasticity[2] After Exposure	Elasticity[2] After Reconditioning[3]	Evaluation
120	10%, room	25.7	−7.6	52	25	42	53	38	24	Poor
	10%, 100° C	16.1	15.5	52	8	28	53	50	35	Poor
	Conc., room	——	——	Disintegrated		—	—	—	—	Poor
125	10%, room	12.7	12.4	50	24	44	42	59	37	Fair
	10%, 100° C	18.4	21.4	50	12	46	42	38	17	Poor
	30%, room	31.3	21.5	50	27	32	42	58	45	Poor
	Conc., room	——	——	Disintegrated		—	—	—	—	Poor
150	10%, room	18.8	6.3	49	26	50	47	40	26	Fair
	10%, 100° C	19.7	63.5	49	14	35	47	32	41	Poor
	30%, room	20.4	6.5	49	9	14	47	35	40	Poor
	Conc., room	——	——	Disintegrated		—	—	—	—	Poor
160	10%, room	13.4	6.0	58	20	51	29	53	40	Fair
	10%, 100° C	22.7	−17.7	58	4	35	29	40	18	Poor
	30%, room	30.9	32.1	58	7	15	29	36	35	Poor
	Conc., room	——	——	Embrittled		—	—	—	—	Poor
160R	10%, room	−0.2	−22.2	57	29	44	42	47	35	Poor
	10%, 100° C	1.0	−30.9	57	26	40	42	41	30	Poor
	Conc., room	——	——	Embrittled		—	—	—	—	Poor
167	10%, room	40.8	21.7	74	8	63	22	27	6	Poor
	10%, 100° C	18.9	25.1	74	4	56	22	26	5	Poor
	Conc., room	——	——	Disintegrated		—	—	—	—	Poor
180	10%, room	−15.2	0.0	80	74	76	21	37	35	Good
	10%, 100° C	0.8	0.2	80	72	76	21	38	40	Good
	30%, room	0.0	1.4	80	75	75	21	47	34	Good
	30%, 100° C	8.4	0.3	80	75	78	21	15	12	Good
	Conc., room	——	——	Disintegrated		—	—	—	—	Poor
181	10%, room	0.0	1.2	81	83	80	11	26	17	Good
	10%, 100° C	0.5	0.1	81	76	80	11	23	17	Good
	30%, room	0.0	1.4	81	83	82	11	36	14	Good
	30%, 100° C	1.0	1.0	81	69	78	11	21	14	Good
	Conc., room	——	——	Disintegrated		—	—	—	—	Poor

[1] Shore hardness, A scale. [2] Shore elasticity. [3] After 7 days in air at room temp

the two electrical insulating resins, DC 993 and 996, and samples of the thermosetting silicone resin, DC 2103, were exposed to dilute and concentrated sulphuric acid at room temperatures and at 100 deg. C. Changes in the weight of discs of DC 993 cured at 250 deg. C., discs of DC 996 cured at 150 deg. C. and typical DC 2103 glass cloth laminates are given in Table II. All of these resins showed excellent resistance to dilute sulphuric acid at room temperature and at 100 deg. C. Concentrated acid caused swelling and other evidences of deterioration in all of the test samples

except for the DC 2103 bonded glass lamination, which showed fair resistance to concentrated acid at room temperature.

Silicone Rubber—Data on the effects of dilute and concentrated sulphuric acid at room temperature and at 100 deg. C. on typical samples of various Silastic stocks are given in Table III. The two stocks, Silastics 180 and 181, which were compounded to give maximum chemical resistance and minimum compression set in gasketing applications showed good resistance to 10 and 30 percent acid at room temperature and at 100 deg. C. Other Silastic stocks showed fair to poor resistance to dilute acid. All of the Silastic stocks were either dissolved or embrittled by concentrated acid.

TANTALUM

LEONARD R. SCRIBNER
Fansteel Metallurgical Corp.,
North Chicago, Ill.

ALTHOUGH laboratory tests indicate that tantalum is attacked by concentrated sulphuric acid at high temperatures, practical experience shows that tantalum equipment can be used safely with sulphuric acid under a wide variety of conditions without loss or damage due to corrosion.

One of the first commercial uses of tantalum was in the Balkite rectifier cell for charging storage batteries, where the tantalum electrode is immersed in a sulphuric acid electrolyte containing iron and cobalt salts. These rectifiers have been manufactured since 1922, and there has never been a reported case of failure due to corrosion of the tantalum electrode.

Tantalum spinnerets have been used for more than 20 years in viscose rayon processes, and tantalum heaters for sulphuric acid spin baths have been in operation for long periods with no reported failures.

A tantalum heater was installed in 1938 to boil a mixture of sulphuric acid, sodium chloride and methanol; it operated without corrosion for several years until the process became obsolete.

Tantalum bayonet heaters have

Corrosion of Tantalum by Sulphuric Acid

Temperature, Deg. F.	Duration of Test	Corrosion Rate, Mils Per Yr.
Concentrated H_2SO_4:		
66–79	135 days	0.00
297	90 days	0.00346
347	30 days	0.123
392	6 hr.	1.53
482	3 hr.	28.8
572		344
Conc. H_2SO_4 containing $K_2Cr_2O_7$ (cleaning solution):		
66–79	135 days	0.00
205	90 days	0.00346
Fuming H_2SO_4 containing 15 percent SO_3:		
73	2 days	0.277
158	6 hr.	92
266	2 hr.	3,950

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Add the facts that stainless steel is easy to clean and keep clean . . . never requires refinishing . . . retains its high structural strength at elevated temperatures . . . and it's easy to see why more and more processors in the chemical, pharmaceutical and food fields are specifying ENDURO on new equipment orders. For complete details, see your fabricator, or write to:

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EASY TO CLEAN • FREE FROM CONTAMINATION • EYE APPEALING • LONG LASTING • LOW ULTIMATE COST

A PRODUCT OF REPUBLIC STEEL

been in use more than a year in Mantius type sulphuric acid concentrators, where it has been found that, because of higher heating efficiency, the use of tantalum heaters has substantially increased the capacity of concentrators.

Dilute sulphuric acid does not attack tantalum at any temperature at which tests have been made, nor does concentrated acid attack tantalum appreciably at temperatures below 170 deg. C. If tantalum equipment is to be used at higher temperatures, it is recommended that tests be made first.

The presence of free sulphur trioxide in fuming sulphuric acid is destructive to tantalum, even at room temperatures.

The accompanying table shows the results of carefully conducted tests in the Fansteel laboratory in which specimens of annealed tantalum sheet 0.15 x 11 x 105 mm., first cleaned in dichromate cleaning solution, were subjected to sulphuric acid. The specimens were weighed on an analytical balance sensitive to 0.1 mg.

HAVEG

E. P. MAMPE
Haveg Corp.
Newark, Del.

MAXIMUM concentration of sulphuric acid for which Haveg is ordinarily recommended is 50 percent, whether intended for a hot or room-temperature application. This concentration, of course, refers to that in water solution, and it should be stressed that there is no sharp break in performance at this concentration. Such factors as temperature and the presence of other chemicals play an important role in stronger solutions and it is therefore advisable to conduct tests under actual or simulated operating conditions where higher concentrations are involved.

Probably the most important field for Haveg involving sulphuric acid is in the metallurgical industry. It is extensively used in the form of cylindrical and rectangular tanks, fume systems, pumps and piping, for copper and steel pickling where acid concentrations of 5 to 20 percent are commonly employed. Its scope in such applications is broadened by its excellent resistance to sulphuric pickling solutions containing other agents such as hydrochloric acid or ferric sulphate. Fabrication of this plastic material in inexpensive molds, and an ingenious joint construction, make feasible the production of long sectional troughs and rectangular tanks for use in the continuous pickling of wire and strips.

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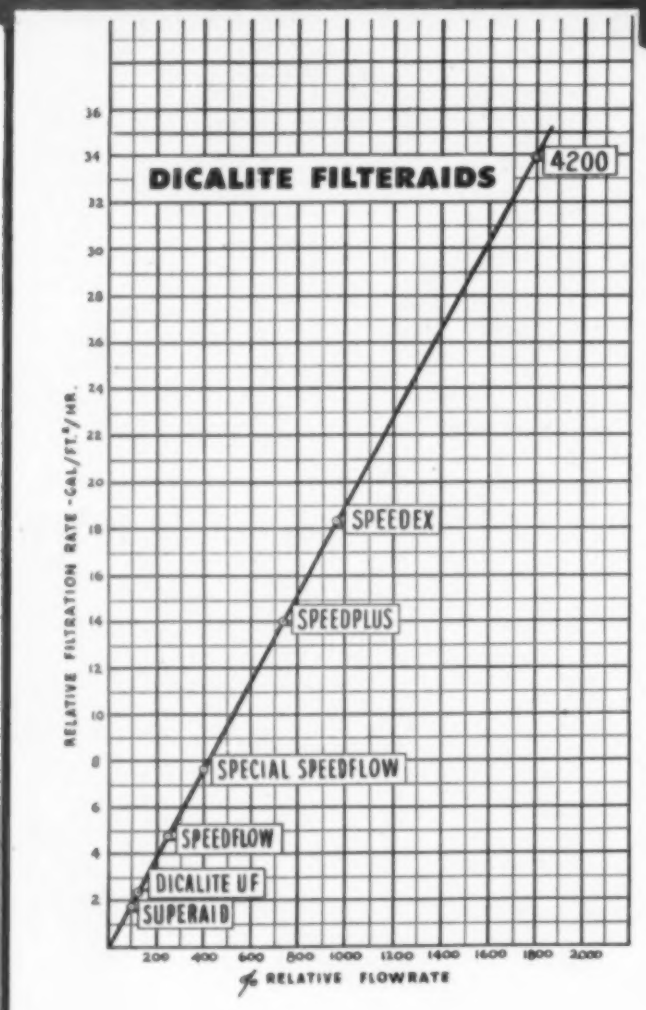

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BULLETIN B-11

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DICALITE FILTERAIDS

NAMES IN THE NEWS

Man of the Month

T. W. Smith

Thomas Woodford Smith of Montreal, elected president of the Chemical Institute of Canada last month just a day before his 62nd birthday, is a native of Dublin, Ireland, and has been associated with chemistry for nearly 40 years. Since April 1940 he has been chairman of the division managers committee of Canadian Industries Limited, a company with which he has more than 35 years service.

A graduate of the Royal College of Science in London, England, Mr. Smith came to Canada after three years as a science master at Magnus Grammar School at Newark-on-Trent. His first job in this country was with the Victoria, B. C., Chemical Co., which was to become part of C-I-L and which he joined in 1912 as chief chemist. Three years later he was made chief chemist at the Beloeil, Que., plant of C-I-L and for the next nine years he was engaged in explosives work at Beloeil and Nobel, Ont.

Then in 1924 he entered the paint and varnish field as technical advisor and plant manager of the Toronto paint and varnish plant.

Three years later he was back with the chemical division at Montreal and for about a year and a half he acted in a chemical advisory capacity to subsidiary companies. In Jaunary 1929 he became assistant manager of the chemical development department and this was followed by a 10-year period as manager of the patent department.

Long active in chemical professional circles, Mr .Smith served as vice president of the Chemical Institute of Canada before his election to the presidency. He is a Fellow of the Patent Institute of Canada and served as its president for the term 1944-46. A past president of the Society of Chemical Industry, he was chairman of the Canadian Section from 1945-47.

His main hobby is golf. He is a member of the Marlborough Golf Club as well as the Engineers Club and the Canadian Club.

W. L. Mellon, for 45 years the active head of the Gulf Oil Corp. has retired from his present position as chairman of the board. He will continue to serve as a director. Mr. Mellon is succeeded as chairman of the board by **J. F. Drake,** president of Gulf since 1931.

W. F. Luckenbach, Jr., has been named manager of industrial sales, and **Daniel W. Duncan,** head of the chemical engineering process improvement section at Virginia Smelting Co., West Norfolk, Va.

John Happel will join the chemical engineering department at New York University. Dr. Happel has been a chemical engineer with Socony-Vacuum Oil Co.

J. Happel

R. Aelion

Rene Aelion, French scientist, has come to the United States to join the research staff of the Polytechnic Institute of Brooklyn. As a research associate in the Institute of Polymer Research, Dr. Aelion will collaborate with Dr. F. R. Eirich, formerly of Cambridge University, England, who was appointed assistant professor of colloid chemistry at the Polytechnic Institute of Brooklyn last fall.

E. Wayne Everhart is now in Spokane in charge of the corrosion laboratory of Permanente's new Kaiser aluminum research department.

Warren K. Venatta has been named manager of product control for Oronite Chemical Co., San Francisco. He will coordinate production availability with requirements. Venatta was formerly group supervisor in charge of gasoline synthesis with California Research Corp., another Standard of California subsidiary.

W. K. Venatta

N. O. Stein

Norman O. Stein, formerly general superintendent of the carbon dioxide plants of Air Reduction Sales Co., New York, and wartime manager of the chemical section, War Assets Corp. of Canada, is now chief technical assistant to the president of Rumford Chemical Works, Rumford, R. I.

Theodore R. Corbett has been appointed manager of the manufacturing department of Carter Oil Co., Billings, Mont. For the past two years he has been manager of the manufacturing department's Northwest division.

William J. Youden, internationally known mathematical statistician and chemist has been appointed to the staff of the National Bureau of Standards as assistant chief of the statistical engineering section. Dr. Youden will work on the statistical and mathematical design of major experiments in physics, chemistry and engineering.

G. Theodore Barks has been appointed general superintendent of the new vinyl chloride production unit of Monsanto Chemical Co. at Springfield, Mass. Barks has been division super-

intendent of U. S. Rubber Co.'s Fisk plant at Chicopee, Mass. **S. P. Lio,** superintendent of the plant technical group has been transferred to operating superintendent of the new vinyl chloride plant and **Louis Schroeder** of the research department is area supervisor.

C. R. Vegh Garzon, of Montevideo, Uruguay, has been appointed consultant in Latin American for the Universal Oil Products Co.

J. W. Langhaar has been transferred from the Du Pont industrial engineering division of the engineering department to the planning division of the ammonia department.

Carl W. Virgin, chief research chemist of the Vulcanized Rubber and Plastics Co., Morrisville, Pa., has been elected chairman of the Trenton section of the American Chemical Society.

John W. Barker, formerly of Houdry Process Corp. and Foster Wheeler Corp., has joined the engineering staff of George Armistead, Jr., consulting chemical engineer of Washington, D. C.

C. L. Rumberger has been named general manager of the research and quality control division of the H. J. Heinz Co. Mr. Rumberger succeeds **C. F. Mayer** who is retiring due to ill health.

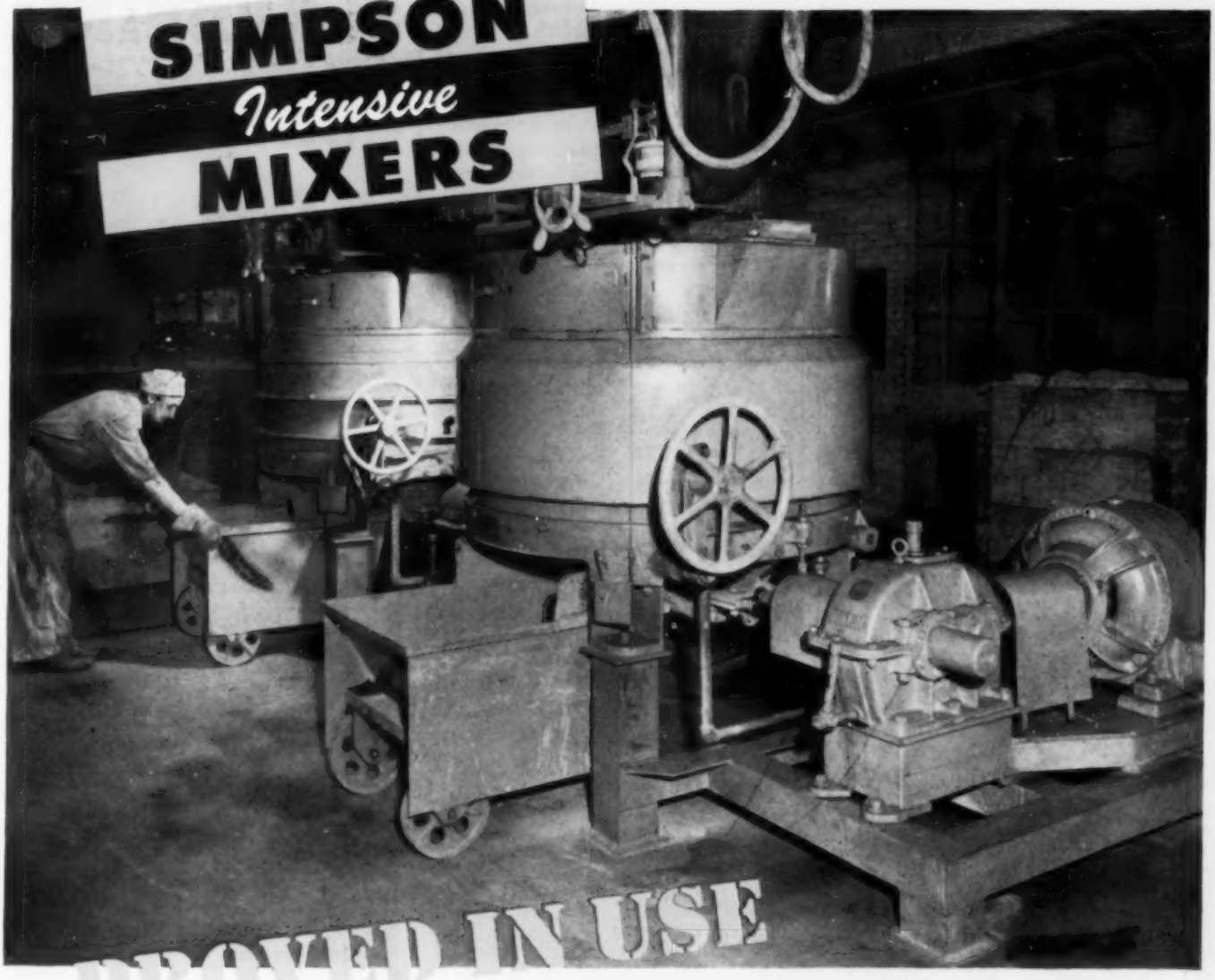
Malvern J. Hiler of Chicago, has been appointed vice president in charge of customer relations for the Commonwealth Engineering Co. of Ohio.

Arthur W. Hixson has retired as executive officer of the department of chemical engineering at Columbia University. **Thomas B. Drew** has been named as his successor. Professor Hixson has been associated with Columbia for 29 years having joined the faculty after he received his Ph.D. degree in 1918. Professor Drew has been associated with the department of chemical engineering since 1940. He was previously a chemical engineer with E. I. du Pont de Nemours & Co.

Winston L. Hole has been appointed assistant to the director of the Ohio State University Research Foundation.

R. F. Miller has been appointed assistant to vice president, research and technology department, Carnegie-Illinois Steel Corp.

Walter Geist, president of Allis-Chalmers Mfg. Co., Milwaukee, and **Leigh Willard,** president of the Interlake Iron Co. and Interlake Chemical Co., were awarded honorary doctor



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Because it provides uniform results, the "controlled mixing" process accomplished by Simpson Intensive Mixers has become an integral part of mixing operations involving dry, semi-plastic and pasty materials requiring rapid, thorough, and uniform mixing and blending without grinding. The smearing, rubbing, and kneading action of these dependable mixers quickly develops maximum bond strength and plasticity in a mix.

Some of the product applications where Simpson Intensive Mixers are being used successfully include *boiler compounds, carbon electrodes, catalysts, crayons, crucibles, glass batching, graphite products, mercury reclamation, paper coatings, pencil leads, putties, silicon carbide refractories, soaps, special shape refractories, storage battery plate pastes, and welding rod coatings.*

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of engineering degrees June 7 by the Michigan College of Mining and Technology at Houghton, Mich.

Albert R. Merz, chemical specialist of U. S. Tariff Commission, retired on June 1 after 28 years of government service. Dr. Merz is planning to travel extensively; but he will retain his residence in Washington.

C. P. Neidig has joined the chemical products division of the Atlantic Refining Co.

Alfred H. White, professor emeritus of chemical engineering at the University of Michigan, received an honorary degree of doctor of engineering June 9 from the University of Detroit.

Eugenio Thomas, partner in the firm of Braun & Braun, Santiago, Chile, is in the United States seeking exclusive arrangements from manufacturers of machinery and chemicals.

Thomas P. Johnston received his doctor of philosophy degree from Emory University last month. This is the first such degree to be conferred in the 113-year history of the school.

George Oenslager and **Waldo L. Semon** have received Charles Goodyear memorial medals awarded by the division of rubber chemistry of the American Chemical Society. Dr. Oenslager, retired, was formerly with the B. F. Goodrich Co. Dr. Semon is director of the Goodrich research center in Brecksville, Ohio.

C. D. Lowry, Jr., of the staff of the Universal Oil Products, has been appointed executive director of the panel on petroleum of the Research and Development Board, National Military Establishment.

Thomas G. Gleason has been added to the New York office staff of the Peabody Engineering Corp. where he will be engaged in studying special applications and in product development work of the scrubber division.

J. P. Remensnyder, vice president of Heyden Chemical Corp. has been named a member of the board of Synthetic Organic Chemical Manufacturers' Association.

Werner Baumgarten, a 1941 graduate of the California Institute of Technology, has joined Merck & Co., Inc., as a research chemist in the research and development division.

Harry B. Baylor, vice president of International Minerals & Chemical Corp. in charge of the plant food di-

vision retired July 1. **Maurice H. Lockwood**, for the past two years president of the National Fertilizer Association, will assume Mr. Baylor's responsibilities.

John H. Sachs, manager of the development division of Du Pont's organic chemicals department, has retired from the company.

Harold J. Edmon has been appointed manager of Naugatuck Aromatics division, United States Rubber Co. He succeeds **M. G. Couderchet**, who is returning to the staff of Bruno Court, Grasse, France, as sales manager.

Daniel D. Cubicciotti, Jr., research assistant at the University of California radiation laboratory, has been appointed research assistant professor at Illinois Institute of Technology. The appointment is effective September 1.

Fred Powell has been made general manager of the El Segundo, Calif., refinery of Standard Oil Co. of California.

Warren S. Peterson has been chosen to supervise the new physical metallurgy laboratory of the aluminum research department, Permanente Metals Corp., Spokane.

R. F. Miller has been appointed assistant to vice president, research and technology department, Carnegie-Illinois Steel Corp.

R. Bowling Barnes has been elected vice president in charge of research and development of American Optical Co., Southbridge, Mass. For the past 12 years Dr. Barnes was director of the physics division of the Stamford research laboratories of American Cyanamid.

William H. Jones, associate professor of chemistry at Emory University, Atlanta, Ga., has received a grant of $3,000 from the Research Corp., New York, for basic research in the field of physical chemistry. Dr. Jones will continue his investigations into the heats of vaporization of liquids.

Raymond R. Edwards has been appointed a research associate in nuclear chemistry at the University of Arkansas Institute of Science and Technology. During the war Edwards was associated with the Clinton Laboratories at Oak Ridge in research in nuclear chemistry.

Paul T. Jones and **James A. Watson, Jr.**, will join the staff of the chemistry department of Texas Technological College, Lubbock, Tex., at the open-

RUBBER RECIPE

Rubber compounds to the tune of some 35 million pounds a year go into Bell System plant. Each compound must meet many requirements for resistance to humidity, oxygen, ozone, light and abrasion. The right properties depend on skillful selection and compounding of ingredients; this is one of the jobs of Bell Laboratories.

Sulphur, one essential ingredient of rubber, can also be corrosive. That seemed to rule out rubber on telephone cords. But Bell chemists found that if they held sulphur to the bare minimum, corrosion ceased. Now your handset cord has long life, is less susceptible to moisture as, for example, from a wet umbrella.

Connecting your home to the telephone wire on the street is a "drop" — one hundred feet or more of rubber-insulated wire. Once this wire was protected from ozone, light and abrasion by an impregnated cotton braid; but water leached the impregnant, and the braid rotted. Bell chemists tested scores of synthetics, and selected neoprene as an exterior covering with many times the life of braid.

Rubber is only one of many types of insulation developed by the Laboratories for the Bell System; insulation is only one of the Laboratories' problems in providing a quick, economical path for your voice.

BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE.

ing of the 1948 fall term. Jones had been chief research chemist with the American Bemberg Corp. for 13 years. Watson has been an instructor in chemistry at the University of Kentucky.

A. P. Beutel, general manager of Dow Chemical Co., Texas division, and **N. D. Griswold**, assistant general manager of the same division, became directors of the company at a meeting in Midland, Mich., last month.

A. A. Stonehill has been appointed director of research and quality control for Tek Hughes, Inc., New York.

Everett W. Price has been appointed to the board of directors of the Woburn Chemical Corp. (N. J.), Kearny, N. J., and Woburn Degreasing Co., Woburn, Mass.

Edmund G. Robinson, general manager of the organic chemicals department, E. I. du Pont de Nemours & Co., since 1929, retired from company service on July 1. He will be succeeded by **John F. Daley**, general manager of the Du Pont pigments department. Mr. Robinson will continue as a member of the company's board of directors.

Isaac Arnold, petroleum industry executive of Houston, Tex., has been elected trustee of Rensselaer Polytechnic Institute.

J. P. Okie has been transferred from the Houston plant of Shell Chemical Corp., where he has been plant superintendent to the company's manufacturing-operations department in San Francisco.

Emil F. Werly, former director of research for the W. C. Hardesty Co., Dover, Ohio, has joined the Pillsbury Mills research and products development department as a chemical engineer. He will do pilot plant work on oil seeds and edible oils.

OBITUARIES

Carl Van Laaten, 57, one of the founders of Merchants Chemical Co. and well-known representative of Wyandotte Chemicals Corp., died in Chicago May 8.

John C. Olsen, 78, author, co-founder of the AIChE, and widely-known teacher of chemical engineering died in Brooklyn June 8.

D. I. Trainer, 67, director of sales, General Chemical division, Allied Chemical & Dye Corp., died at his home in Media, Pa., June 10.

INDUSTRIAL NOTES

Hall China Co., East Liverpool, Ohio, soon will construct a plant addition to house a new circular glost kiln and to provide kiln shed space.

J. F. Kress Box Co., Pittsburgh, will build a million dollar plant in Newark, Ohio, for the manufacturing of corrugated fiber boxes and related products.

Virginia Smelting Co., West Norfolk, Va., has appointed W. F. Luckenbach, Jr. manager of industrial sales. Daniel W. Duncan has been named head of the chemical engineering process improvement section.

Ira G. Perin Co., San Francisco, Calif., has appointed James W. Lafferty technical sales engineer.

Dow Chemical Co., Midland, Mich., has transferred John C. Chamberlain from the production control section of the plastics sales division to enter sales training for the company.

Los Angeles Chemical Co., Los Angeles, is moving its Calkins division to 1960 Santa Fe Ave.

Givaudan-Delawanna, Inc., New York, has begun construction on a two-story steel and concrete building on the site of their plant at Delawanna, N. J.

Chemical Development Corp., Cambridge, Mass., is prepared and equipped to undertake the process development and manufacture of chemicals and chemical formulations on a confidential basis.

General Aniline & Film Corp., New York, has elected Horace C. Flanigan a member of the board of directors.

Mixing Equipment Co., Rochester, N. Y., has installed its entire manufacturing operation in a new plant located in the outskirts of the city.

Pittsburgh Corning Corp., Pittsburgh, has added Robert W. McKinley to its newly formed development group.

Blaw-Knox Co. has received a contract from Soy-Rich Products, Inc., for the construction of a 75 ton per day soybean solvent extraction plant at Wichita, Kansas.

Dow Corning Corp. has opened a branch office at Dallas. The office, under the supervision of Max H.

Leavenworth, will handle distribution and sales serving Texas, Louisiana, Oklahoma, Kansas, Colorado and New Mexico. Previous to his transfer to Dallas, Leavenworth had been technical sales representative in Michigan for two years.

Hood Chemical Co., manufacturers of soap and bleaches at Lisbon, O., will rebuild its plant. Engineers are reported to have been engaged to give an estimate on the cost of construction and the length of time. Loss from the fire is estimated at $500,000.

Combustion Engineering Corp., New York, has opened an office in Tulsa, Okla., in the Oil Capital Bldg. to handle sales activities in and around Oklahoma. C. J. Grossi has been moved from Paterson, N. J. to take charge of the new branch.

Opening of the Tulsa office enables the company to maintain close contact with such new construction projects as the Stanolind Oil & Gas Co. Synthol plant at Garden City, Kans., the $27 million refinery expansion program of The Texas Co. at Tulsa and the $7 million expansion of the Mid-Continent Petroleum Corp. at Tulsa.

Crown Zellerbach Corp., San Francisco, is establishing a new sales department in conjunction with the plant production of multiwall bags. This product new to the firm, will be manufactured at Port Townsend, Wash., by the end of the year. Sales manager will be H. O. Nichols, formerly manager of the eastern division in New York City. He was recently elected president of the Kraft Paper Assn.

Dow Chemical Co., Midland, has appointed Walter A. Sheehan of the Boston office plastics and protective coatings salesman. Lemuel D. Harvey of the Houston office has taken up new duties as a plastics and industrial chemicals salesman.

Pabst Brewing Co., Milwaukee, has completed a new research building located on 11th and McKinley Streets in Milwaukee.

St. Joseph Lead Co., New York, has appointed Charles R. Ince sales manager to succeed Irwin H. Cornell who has retired after 38 years.

Philadelphia Quartz Co., Philadelphia, has appointed Donald G. Dyer to its adhesive-sales service.

Allegheny Ludlum Steel Corp., Pittsburgh, has made W. F. Detwiler honorary chairman of the board of directors. Lester H. Bittner has been

IT'S THE NEW LOW TEMPERATURE BUFLOVAK EVAPORATOR THEY'RE TALKING ABOUT!

You will surely want to know about this new Downflow Evaporator built by BUFLOVAK. It operates at unusually low temperature . . . suitable for the most delicate materials!

New features include large capacity, with only small quantities of material in the evaporator, and an extremely short processing cycle! Furthermore, its high rate of recovery of solids means real savings to you in your processing.

At all times, you get uniform heating with BUFLOVAK'S Low-Temperature Evaporator, so important in processing delicate heat-sensitive products.

We cordially invite you to write today for full details on this New BUFLOVAK Evaporator.

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CHEMICAL AND FOOD PROCESSING EQUIPMENT
includes:
DRYERS
EVAPORATORS
SOLVENT RECOVERY EQUIPMENT
PROCESSING KETTLES

elected to the newly created position of vice president in charge of purchases.

Bird Machine Co., South Walpole, Mass., has appointed F. X. Ferney assistant sales manager.

National Research Corp., Cambridge, Mass., has licensed exclusively Smith Paper Inc. of Lee, Mass., to produce metallized paper for use in electrical condensers.

Economy Pumps, Inc., Hamilton, Ohio, has appointed Beldon S. Tucker to head its new Chicago office. Bruce Hetler has been made the distributor for Western Michigan.

Sharp & Dohme, Philadelphia, has combined its Atlanta and Jacksonville district sales offices into one office in Atlanta. The stock at Jacksonville is being moved to new quarters in Atlanta. P. M. Gowder, Atlanta district sales manager, said that the company will have 20,000 sq. ft. with 20,000 sq. ft. of parking space which could be used for future expansion.

American Rolling Mill Co., Middletown, Ohio, has changed its name to Armco Steel Corp. The change does not involve any change in the company's structure, personnel, or policies.

Thurston & Braidich, New York, has appointed Hukill Chemical Corp., Cleveland, to handle their line of gums for the varnish, lacquer and allied industries.

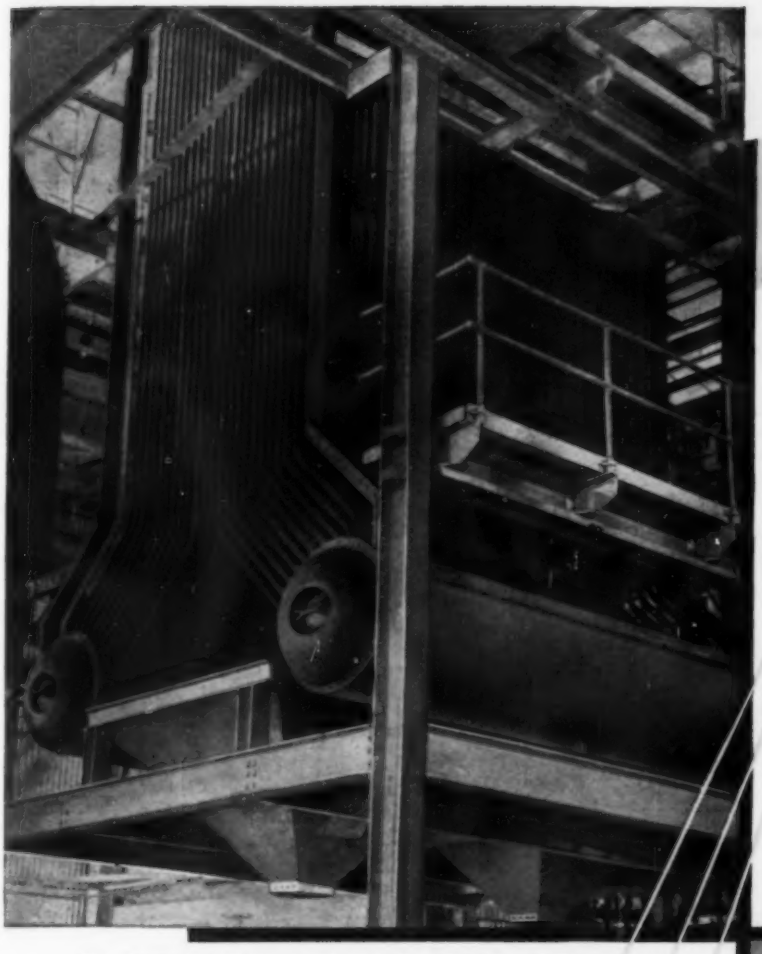
Locke Inc. is the new name for the Locke Insulator Corp., Baltimore, Md.

General Electric Co., Schenectady, has appointed Charles W. Bentley assistant to the manager of a new Decatur, Ill., plastics molding plant. David B. Folkerth has been named chemical department district representative at the Pittsburgh. Frank E. Golliher has been made production supervisor of the plastics division.

Hydraulic Press Mfg. Co., Mount Gilead, Ohio, appointed Howard M. Hubbard as president.

Claude B. Schneible Co., Detroit, has placed George C. Schreiber in charge of the Northern Illinois and Wisconsin territories with headquarters in Chicago.

Pennsylvania Salt Mfg. Co., Philadelphia, has appointed William D. Wilson as district sales representative in northern New Jersey and New York City for the special chemicals division. John M. Davidson has been named as



This Foster Wheeler waste heat boiler, shown partially erected, is used for cement mill waste heat recovery.

save energy

PAPER MILLS

FW waste heat boilers are used in sulphite paper mills for cooling SO_2 gas.

AMMONIA MANUFACTURE

Gas processing by means of heat recovery in the manufacture of ammonia is effected most economically by FW waste heat boilers.

COPPER SMELTING

In the plant of a copper and smelting refining company in Utah FW waste heat boilers generate steam for plant operation at 430 lb. pressure and 700°F. final steam temperature.

FOSTER WHEELER WASTE HEAT BOILERS

CEMENT INDUSTRY

In dry process plants where the pulverized rock is delivered to the calcining kilns in a dry state, sufficient steam can be generated by FW waste heat boilers to provide all of the power requirements of the plant including quarrying, grinding of rock, operation of kilns, grinding of clinker, transportation and loading.

PETROLEUM INDUSTRY

A large portion of waste heat in petroleum refining may be recovered by the use of FW waste heat boilers. In some cases, sufficient steam can be generated to operate an entire distillation or cracking unit.

CHEMICAL PLANTS

Waste heat boilers of a wide variety have been developed by FW for use in chemical plants.

How can you achieve maximum fuel economy and effective temperature control through waste heat recovery at your plant?

Where can waste heat boilers with extended surface elements be used to best advantage? These and many other questions are answered in Catalog WHB 47-4. Write

FOSTER WHEELER CORPORATION
165 Broadway, New York 6, N. Y.

FOSTER WHEELER

the division's Pittsburgh district sales representative.

Houdry Process Corp., Philadelphia, is consolidating its executive, sales and engineering headquarters in Philadelphia.

Air Reduction Sales Co., New York, has appointed Walter Wilkinson manager of the newly formed liquefaction division. The division will have four sections: a process analysis section under J. L. Schlitt; a physics section headed by Dr. C. C. Van Nuys; an experimental section under Wolcott Dennis and a special projects section headed by William Soherr.

Maas & Waldstein Co., New York, has elected G. Klinkenstein, formerly vice president and general manager, president.

Cabot Carbon Co., Boston, subsidiary of Godfrey L. Cabot, Inc., will have its southwestern headquarters in Pampa, Tex.

Masonite Corp., Chicago, has appointed T. M. O'Neil manager of its chemical products division.

Marley Co., Inc., Kansas City, Kan., has changed its Los Angeles office address to 810 South Sprint St. Harold A. Dresser has joined the Los Angeles sales department.

Young Radiator Co., Racine, Wis., has purchased the Atlas Imperial Diesel Engine Co. plant and facilities at Mattoon, Ill.

Reinhart Chemical Corp., New York, has moved to the Chrysler Building, 405 Lexington Ave.

Centro Research Laboratories, Briarcliff, N. Y., is expanding activities to meet current and future needs in connection with governmental projects now being inaugurated.

Ebasco Services Inc., has appointed A. P. Schnyder as engineer for pulp and paper mills.

Commercial Solvents Corp., New York, has appointed C. R. Woodfill manager of the industrial chemical division.

Interchemical Corp., New York, has elected Harry J. Hemingway to the board of directors of the corporation.

Diamond Alkali Co., Cleveland, has appointed J. C. McKenna manager of chromium chemical sales. D. G. Hood has been named to supervise sales to the glass industry.

NATIONAL AIROIL FUEL OIL - GAS BURNERS

THE *RIGHT* BURNER

OR COMBINATION OF BURNERS FOR *YOUR NEEDS*

The factory, salesrooms and general offices of National Airoil Burner Company, Incorporated, are housed in this modern daylight plant at "L" Street, Sedgley Avenue and Pennsylvania Railroad, in the great Northeast industrial section of Philadelphia.

Whether you burn oil, gas or a combination of these fuels, there's a NATIONAL AIROIL BURNER for your job.

Our more than 35 years' experience in the design, development and manufacture of all types of industrial burners is at your service.

Ask us about your requirements . . . we'll gladly give you full information.

TYPE "SA"

Uses steam or compressed air for atomization. Thoroughly atomizes and completely burns the lowest and cheapest grades of fuel oil and tars. Requires only low oil pressure and temperature.

TYPE "SAL"

Large capacity burner of steam atomizing type. Adaptable to large boilers or dual fuel systems. Is frequently used for firing boilers above existing coal grates.

TYPE "SAR"

(Where steam, or gas is available for atomizing) safely and efficiently burns residuums obtained from process.

COMBINATION GAS AND OIL BURNERS

An "Airocool" Gas Burner in combination with a Type "SAR" Steam Atomizing Oil Burner. Type "SAR," safely and efficiently, burns residuums obtained from process.

"AIROCOOL" GAS BURNER

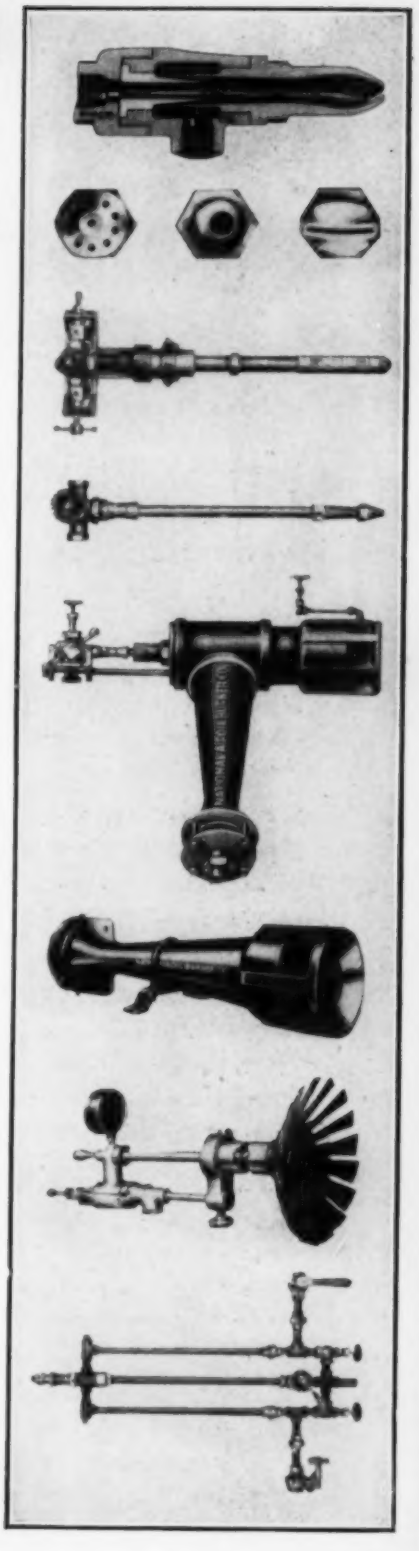
Venturi type. Patented, long-life "Airocool" Nozzle assures trouble-free operation and provides low turndown without burnback.

MECHANICAL—PRESSURE ATOMIZING OIL BURNER

with multi-vane type air diffuser to give a positive swirl to entering combustion air.

TYPE "S-A-D"

(Refuse Oil Burner) burns acids or caustic oils, sludges, asphalts, tank bottoms, polymer oils, heavy petrolatum, organic oil residuums, waste cutting oils, sulphite pulp liquors in combination with fuel oil.



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CONVENTION PAPER ABSTRACTS

CONTENTS

Acetic + Anhydride = Corroded Aluminum

IN THE manufacture, shipment and use of glacial acetic acid considerable use is made of aluminum vessels and pipelines. Corrosion resistance of this material is very good when, as is normal, the acetic acid contains traces of water. In perfectly anhydrous acetic acid, however, the rate of corrosion is quite rapid and care must be taken in industrial practice to ensure that anhydrous acetic acid does not come into prolonged contact with aluminum. The only circumstances under which anhydrous conditions are likely to be produced and maintained is by the addition of acetic anhydride to acetic acid. The rate of corrosion of aluminum by acetic anhydride is greater than that by glacial acid but is much smaller than the rate by anhydrous acid. From the corrosion standpoint therefore, it is the presence of small amounts of acetic anhydride in acetic acid which is particularly undesirable.

G. Benson and R. M. Kitchen, Shawinigan Chemicals Ltd., before Canadian Institute of Chemistry, Montreal, June 1948.

Polythene and Teflon

POLYTHENE was first produced by the English and was introduced to this country by the Navy during the war. Polythene is the trade name for polyethylene, and is produced in varying grades having different molecular weights. The most common grade has a molecular weight of 18,000.

Outstanding characteristics of Polythene are its specific gravity (0.85-0.90), ease of fabrication, superior electrical qualities, and relatively low cost. During the war, the American output was used by the Armed Serv-

ices for shielding of electrical cable. The postwar lead shortage has increased the demand for the plastic sheathed type cable, one communications company replacing all their old cable with the newer, plastic sheathed type.

Teflon, the trade name for polytetrafluoroethylene, has aroused widespread interest because of its complete inertness to any known chemicals and its wide temperature range of operation. It is usable from −50 deg. F. to 327 deg. C., the transition point where the material softens.

To date, it has not been possible to determine the molecular weight of Teflon because its inertness prevents the use of known methods for this determination. It is quite dense, having a specific gravity of 2.2.

The method of fabrication of Teflon include the use of powdered metal techniques, wherein the grains are cold pressed, followed by sintering at temperatures above 327 deg. C. transition point. The rate of extrusion, 1 ft. per hr., is slow.

E. B. Yelton, Jr., E. I. du Pont de Nemours & Co., before Knoxville-Oak Ridge Section, American Institute of Chemical Engineers, Knoxville, May 22, 1948.

Engineering Education—Plus

TODAY, social studies are receiving emphasis as desirable adjuncts to an engineering education. Several schools are stressing this point; others are debating the procedure to follow; still more are talking about the subject.

Industrial employers of engineers are increasingly interested in educational courses that encourage young men in understanding human values in labor, economics and history. The test of the challenge lies in the ability of the colleges of engineering and other colleges in our institutions to cooperate effectively in the right courses.

Development of a strong professional consciousness by engineers is desirable from several standpoints. One much desired result can be the breaking down of narrow parochialism which too often is noticed in engineering societies through actions which indicate a sort of inbreeding. Another beneficial result is the rise in public esteem for engineers which will follow a professional consciousness among engineers.

With the basic elements of an engineering education—science, technology, professionalism and the social studies established in reasonable proportions—what then remains to follow the "plus" sign on the left of our educational equation?

The last element necessary to complete the education of the engineer is

FOR SALE
on Sealed Bid

78,000 K.W.
RECTIFIER INSTALLATION
TO MEET LARGE D. C. POWER REQUIREMENTS

Input, 13,800 volts, 3 phase, 60 cycle, A. C.; Output, 650 volts, D. C.

INCLUDING TRANSFORMERS, SWITCHES, SWITCHGEAR, SUBSTATION STRUCTURES, RECTIFIERS, CIRCUIT BREAKERS, REACTORS, RELAYS, CONTROL BOARDS, BUS SYSTEMS, AND AUXILIARIES — OVER 700 ITEMS.

LOCATION AND INSPECTION:
Equipment is in original operating positions at former Alcoa Plant, Burlington, N. J. Engineering inspection may be arranged through the Philadelphia WAA Regional Office, Walnut 2-8770, Extension 799.

GENERAL CONDITIONS OF SALE:
Equipment is offered to priority and non-priority buyers on a priority preference basis. Prospective buyers may bid on the entire unit or on one complete Rectifier line plus items not exclusively a part of any one line.

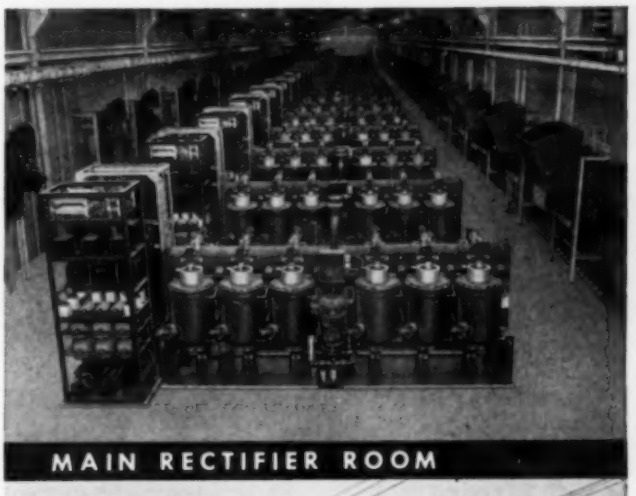
IMPORTANT

Send for SPECIAL LISTING PHL-61-452 for SPECIAL CONDITIONS OF SALE AND SPECIAL TERMS.

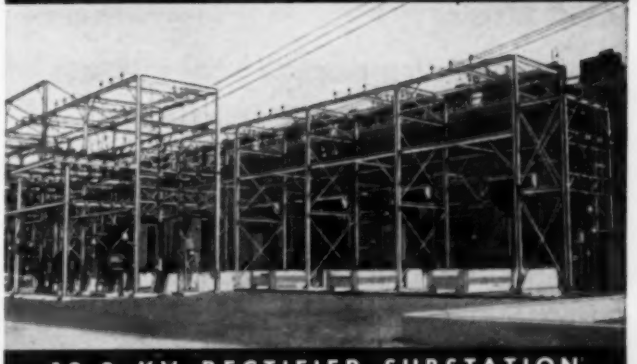
BIDS OPENED—10 A.M. (EDST) JULY 30
at Philadelphia WAA Customer Service Center.

VETERANS OF WORLD WAR II, purchasing for use in their own small business, agricultural or professional enterprises must certify that they, or they together with other eligible veterans, own more than 50 percent of the proprietary interest in the enterprise for which they are purchasing.

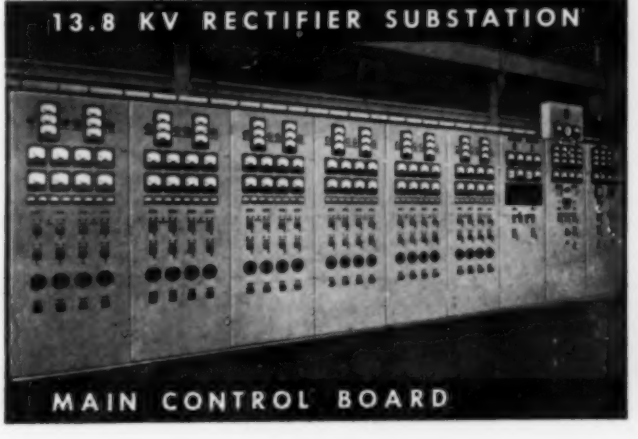
All items currently being purchased by the Federal Government for National Defense are subject to withdrawal, transfer or purchase with priority by the National Military Establishment, up to the time of a contractual commitment for sale.



MAIN RECTIFIER ROOM



13.8 KV RECTIFIER SUBSTATION



MAIN CONTROL BOARD

WAR ASSETS ADMINISTRATION

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one which many of us are either reluctant to try to teach or feel too little qualified to approach. This element is allegiance to honor. We must realize our great opportunity to set high standards of behavior by example. The youth we are privileged to instruct need as never before every aid to hold their aspirations for a better world. They need guidance toward the rewards of honest work, charity of viewpoint, tolerance and a dedication to service, which are attributes of good citizenship.

C. E. MacQuigg, president of the society, before American Society for Engineering Education, Austin, Tex., June 14-18, 1948.

A Unit Operations Laboratory

THE UNIT operations laboratory can be and should be the most important technical course in the chemical engineering curriculum. It is here that the fundamental principles are applied to the study and solution of a given problem.

Many production supervisors, research directors, plant managers and others have been questioned concerning the work of young chemical engineering graduates. These officials have almost unanimously agreed that the young men have had a good technical education and can solve problems. However, they also agree that the men have weaknesses in the following order of importance: (1) inability to write good reports; (2) lack of good grammar either in speech or writing; (3) lack of appreciation of the economic factor in the selection, design or operation of a process; (4) a low degree of initiative in setting up an experiment to procure data; (5) poor judgment in determining the necessary quantity and quality of data; (6) no appreciation of safety in work.

The unit operations laboratory at the University of Texas is operated in such a manner that at least the first five of these weaknesses may be remedied. No definite program of safety is in effect at present.

The unit operations laboratory course is a two-semester arrangement. In the first semester groups of three men each are assigned one project each week for six weeks and one long-term project for the remaining eight weeks.

In order to develop initiative, methods of procedure are not typed out for the men to follow in recipe fashion. The men are encouraged to proceed on the basis of principles with which they are familiar by reason of their general training. However, early in the semester it may be necessary for the instructor to make suggestions on procedure, but he does not outline the attack.

A difficult point with young men is determination of the amount and qual-

ity of experimental data required. The engineers are taught how to plot the governing equations of a problem to ascertain the definite relationship of the experimental data. The plotting of such data will show the erratic runs and indicate which ones must be repeated. The instructor comments frequently and advises groups which are in difficulty.

In order to stress the importance of the dollar sign in engineering work a process design problem is included in almost every project assignment. From the experimental data the men must find the optimum operating conditions for the solution of the particular problem. Results of the process design calculations and the recommendations are included in the formal report covering the project.

With respect to report writing, data obtained in the laboratory or library and all results of experimental work are useless if not accurate, arranged logically and presented clearly. Students are required to use a certain form of report. It is necessary for the laboratory to have a standard report form which gives the students an insight into the principles of proper written presentation of data and conclusions.

John J. McKetta, Jr., University of Texas, before American Society for Engineering Education, Austin, Tex., June 14-18, 1948.

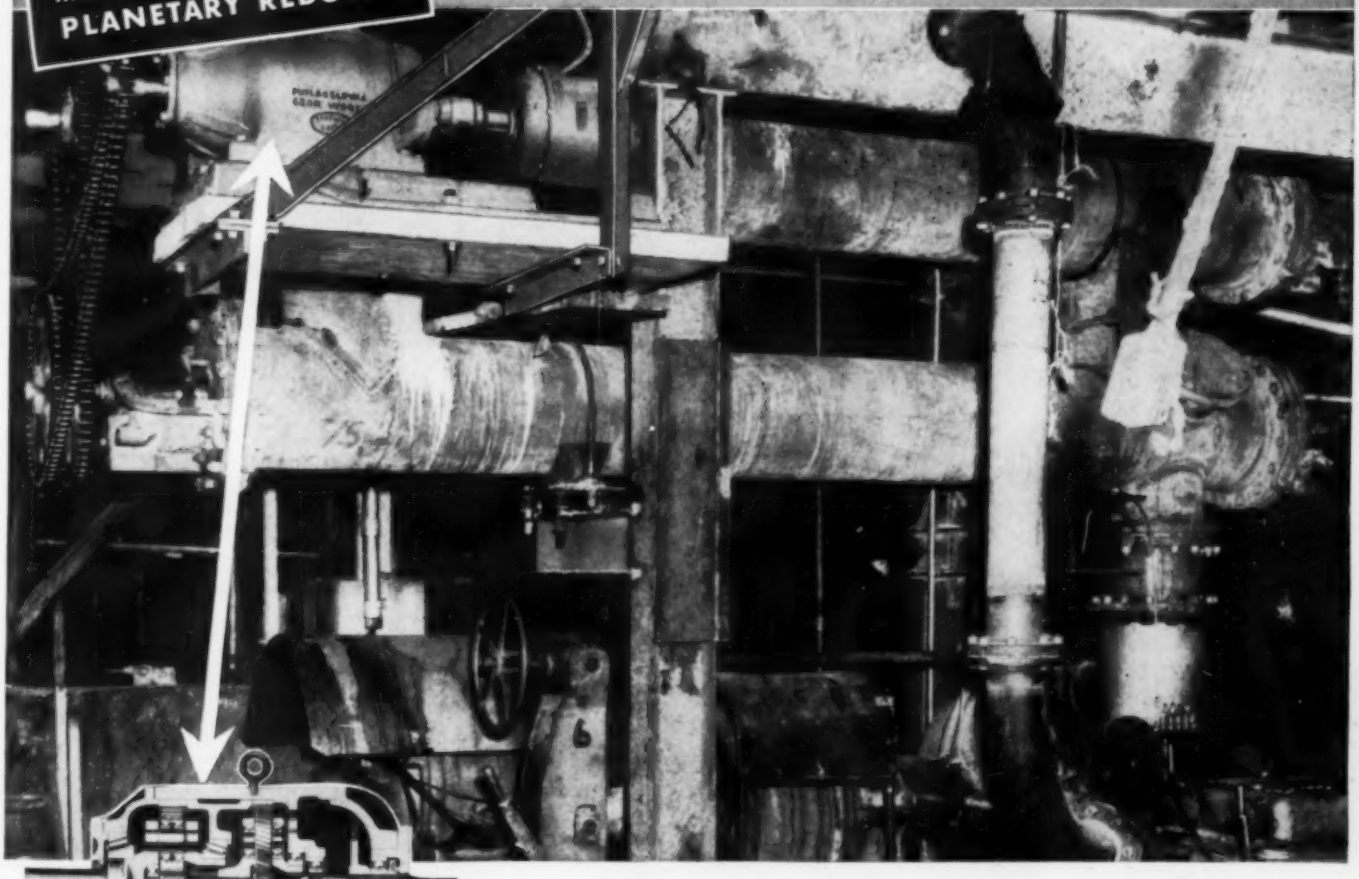
Permeability of Polyethylene

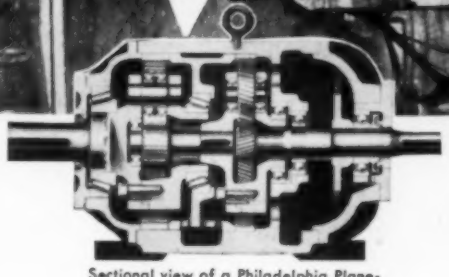
THERE has been a steadily increasing demand for polyethylene for the packaging of chemicals and cosmetics. Liquids as well as solids are packaged in polyethylene, which is now supplied as blow molded bottles, flat sheeting, layflat seamless tubing, and in other forms. As in the case of most new materials, there is need for basic information on some of the properties of polyethylene. While there are data available as to its resistance to chemicals, it is particularly difficult to find information on the permeability of liquids through polyethylene with the exception of reports on water vapor transmission.

A very simple test for determining the rate of transfer of liquids through polyethylene film was developed and used. Table 1 gives the permeability values (expressed in gm. per 24 hr. per 100 sq. in. per 0.001 in. of film thickness) for 36 polar materials. A wide variety of liquids was tested, including water, organic acids, esters, ethers, ketones, alcohols, halogenated materials, liquids of both aliphatic and aromatic types, and nitrates and other nitrogen-containing materials. The range of permeability values is wide, extending from 0.02 to 720, and even higher values are found in the non-

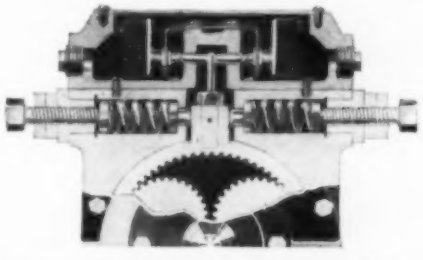
PLANETORQUE installed on a Philadelphia **PLANETARY REDUCER**

Chosen for this vital job because nothing else would do





Sectional view of a Philadelphia Planetary Gear Speed Reducer, double reduction type.



Cut-away view of Philadelphia "PlaneTorque"—the switch responds to overloads *more quickly* than electrical thermal relays, since the mechanical action of the overload operates the cut-out switch directly.

"PlaneTorque" can also be used on either horizontal or vertical Philadelphia "MotoReduceRs," which are available in a wide range of horsepowers and ratios.

Paper and Industrial Appliances, Inc., New York City, had to secure a reduction drive which would *automatically shut-off* the motor when the load increased (even slightly) on the IR CHEMIPULPER, manufactured for a large Eastern felt mill. They tried various electrical and mechanical devices, but none would suit their requirements—so in their own words: "The principle involved (in the "Philadelphia PlaneTorque") appealed to us because, before the screw loading could increase sufficiently to damage a screw, the "PlaneTorque" would shut-down the motor, thereby avoiding any damage to the screws. The first "PlaneTorques" we installed shut-down the CHEMIPULPER Drive motor in a number of cases and avoided damage to our equipment."

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polar liquids. It is believed that values could be reproduced to ±5 percent to 10 percent using this particular test with constant temperature conditions. Inasmuch as these tests were run under uncontrolled laboratory temperature conditions, some of the listed values may vary by as much as 25 percent or even 50 percent in a few cases.

Table 2 lists permeability values for 12 non-polar liquids. In general it can be seen that polyethylene is a poor barrier for these liquids.

Table I—Polar Materials

Material	Permeability
Ethylene glycol	0.02
2-Nitro 1-Butanol	0.05
Dimethyl phthalate	0.09
Water	0.16
Hydrogen peroxide 30%	0.33
Formic acid 85%	0.48
Old Spice cologne	0.60
n-Octyl alcohol	0.68
Phenol 94%	0.70
Ethylene chlorohydrin	0.72
Allyl alcohol	0.95
Auvergne cologne	1.1
n-Butyl alcohol	1.2
Acetic anhydride	1.3
Methyl alcohol	1.6
Ethyl aceto acetate	1.8
Nitroethane	2.0
Nitromethane	2.1
Aniline	2.4
Nitrobenzene	2.6
Glacial acetic acid	2.6
Acetone	7.6
Methyl ethyl ketone	15
Ethyl acetate	21
Propionaldehyde	25
Dimethyl aniline	27
Pyridine	29
Acetyl chloride	38
Mono chloro benzene	38
Butyl acetate	40
o-Dichloro benzene	59
Ethylene chloride	79
Dibutyl ether	200
Diethyl ether	410
Ethyl bromide	680
Chloroform	720

Table II—Non-Polar Materials

Material	Permeability
Kerosene	18
Dioxane	20
Turpentine	61
Styrene	240
Xylene (commercial)	280
Toluene	320
Gasoline (with TEL)	440
Petroleum ether	470
Benzene	490
Carbon tetrachloride	600
Liquid bromine	2,100
Carbon bisulphide	5,200

J. H. Parliman, Plax Corp., before the Society of the Plastics Industry, Atlantic City, May 20, 1948.

Nothing's False, Nothing's True

KNOWING the probabilities associated with the interpretation of an experimental result, the scientist can move with greater confidence, either to apply his finding to practical purposes or to reinvestigate the phenomena involved.

The use of statistical techniques in experimental work leads to a new concept and philosophy of the relationship of the experimenter to the physical world. In this concept, nothing is either surely true or surely false; things are only relatively probable or

relatively improbable. New procedures for scientific investigation based on this philosophy take into account errors due to human failings or inaccurate instruments.

While phenomena in nature are exact and reproducible, our observations of them are faulty and subject to variation from a large number of small errors, which may be due to impure materials, imperfect measuring instruments, human errors, uncontrolled factors, or the like. In order to be sure that the main effect exists as the scientist suspects, it must be large in comparison to the variations encountered in measuring it. In order to judge whether the main effect is real or not, the scientist may either calculate the plus or minus limits for the main effect and consider how small it could be, or he can calculate the probability that the variations in measurement would give rise to a value for the effect as large as that obtained.

W. L. Gore, E. I. du Pont de Nemours & Co., before the Division of Paint, Varnish and Plastics Chemistry, American Chemical Society, Chicago, April 21, 1948.

86-Sec. Iodine

At least 160 radioactive isotopes of 35 different chemical elements are produced when uranium undergoes nuclear fission. In general, the isotopes whose half-lives are only a few minutes or seconds cannot be isolated before they disappear by decay. The chemical nature of iodine, however, permits a very rapid and clean separation from all the other fission elements. The half-life has been redetermined as 86 ±1 sec. This was facilitated by measuring the radiation which passed therough a 2-mm. aluminum plate. The aluminum absorbed much of the beta-radiation coming from other iodine fission products, but the extremely hard beta-rays of 86-sec. iodine were absorbed only slightly.

It was found that an aluminum thickness of 12.6 mm. is required to completely absorb the 86-sec. iodine beta-rays; thus their maximum energy must be 6.54 million volts. This is the highest beta-ray energy yet recorded for any known fission product. The gamma rays were also found to be harder than those of any other identified fission isotope. A thickness of 17.3 mm. of lead was needed to reduce the gamma intensity to one half, thus establishing the energy as 2.9 million volts.

Mass number of the 86-sec. iodine was shown to be most probably 136. Mass numbers 137, 138, and 139 were ruled out because it was shown that the 86-sec. iodine does not decay to

The mirror shown here was made from the first piece of plate glass made commercially in this country. It was cast in 1870 in the factory of Captain J. B. Ford and now adorns the home of his granddaughter, Mrs. Nell Ford Torrey.

This glass reflected a bright future for an infant American industry

Back in the days before the bustle, when gaslights gleamed in the nation's homes, an enterprising gentleman began to tackle the problems of making *plate glass* commercially.

His experiments resulted, many years later, in three thriving glass factories in Western Pennsylvania. The region roundabout provided his plants with an abundant supply of coal, natural gas, white sand and grinding sand. But he lacked the all-important alkali, Soda Ash. And Soda Ash, in turn, required a source of limestone and salt.

In 1890, while traveling northward on the train, the glass-maker heard a fellow-passenger's "hard luck" story of a rolling mill that had drilled for natural gas in Wyandotte, Michigan, and struck *rock salt* instead.

For Captain J. B. Ford, founder of America's plate glass industry, the tale of the "useless" salt ended a long search for a vital raw material.

On "hard luck," courage and a hunch, Captain Ford—then a man of eighty—stepped off the train to establish the company that is now Wyandotte Chemicals Corporation.

Throughout its 58 years of growth, Wyandotte has maintained its interest in the glass industry and remains today one of the principal suppliers of Soda Ash.

During 1948, with a plant expansion of $25,000,000, the company will place in operation facilities which will materially increase its production of this basic chemical.

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the well-known xenon or cesium isotopes of these masses. Assignment to a mass below 136 is improbable.

C. W. Stanley and S. Katcoff, Los Alamos Scientific Laboratory, before Division of Physical and Inorganic Chemistry, American Chemical Society, Chicago, April 19, 1948.

The Decline of Coal-Based Chemicals

THE DAY of expansion of the organic chemical industry based on coke-oven naphthalene and benzene has reached the twilight stage. Further substantial growth depends on new sources of supply, either from petroleum or by the treatment of coal in new ways.

The supply of napthalene and benzene has been dependent almost entirely on the operations of the by-product coke ovens in the steel industry, and in the manufactured domestic gas industry, the naphthalene being obtained mainly from the byproduct coke-oven tar, and the benzene from the coke-oven light oil, derived by scrubbing the coke-oven gas. The use of coke ovens in the production of domestic gas has been static or declining over the past two decades so that the really important source of supplies depends on steel.

Steel and coke oven operations reached a peak in 1929 which was only exceeded in the war period of 1940-1944, with a sharp drop in 1945-6 due to the coal and steel strikes and renewed upward trend in 1947. The plans for coke oven expansion are such that further growth will be slow.

It will be of great interest to watch new developments in coal treatment and in coal byproducts which may extend the field of industrial organic chemistry on the basis of raw materials at a price low enough to encourage such developments. Unless such develop, coal-based products seem fated to be of steadily decreasing importance in the field of synthetic organics with greater and greater emphasis on products based on petroleum or natural gas.

John M. Weiss, before American Institute of Chemical Engineers, Cleveland, May 12, 1948.

Radiocolloids

INTERPRETATION of where radioactive elements go following the explosion of an atom bomb over land or over water will depend to a large extent on a knowledge of radiocolloids.

The existence of these radioactive particles, which may be grains of solid matter, droplets of liquid, or bubbles of gas dispersed in other substances, has been known for years. They have

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now attained special significance in view of the increasing use of radioactive materials.

Under certain conditions, radioactive elements from the splitting of the uranium atom have been found to act in a disconcerting manner. They tend to stick to the walls of vessels, to settle out from solution, to move about slowly and, in short, to do the unexpected.

It has been found that when these troublesome properties of radioactive elements occur, they are probably due to the coming together of individual radioactive molecules to form large colloids, and because these particles happen to be radioactive they are called radiocolloids. The properties of radiocolloids are best summed up by describing them as sticky, sluggish, and obstinate.

Any radioactive element can become a radiocolloid. The principal condition under which a radioactive element present in solution becomes a radiocolloid is through a reduction of its solubility to such a point that, if the radioactive elements were present in weighable amounts, it would form a visible precipitate.

A knowledge of the conditions under which radiocolloids may be formed is of great importance when the design of experiments using radioactive elements is made. This is true in the fields of chemistry, physics, or biology. For example, the nature of the distribution and excretion of a radioactive element present in the body involves a consideration of the rate and extent of radioactive colloidal properties. An analysis for radioactive element may appear to be erroneous because part of the radioactive element may be stuck to the walls of its container.

J. Schubert, Argonne National Laboratory, before Division of Colloid Chemistry, American Chemical Society, Chicago, April 19, 1948.

Non-Electrolytic Chlorine

CONSIDERABLE interest in non-electrolytic processes for the production of chlorine developed during the early part of the war because of unprecedented demands and the possibility of shortage of electrical power. A general interest still exists in such a development due to the economic desirability of divorcing the manufacture of chlorine and caustic now co-produced in the electrolytic processes.

While the demand for caustic at present exceeds that produced with chlorine, it is the general belief that the market for chlorine will continue to expand even beyond the peak of the war effort. The increased value of byproducts and the availability of

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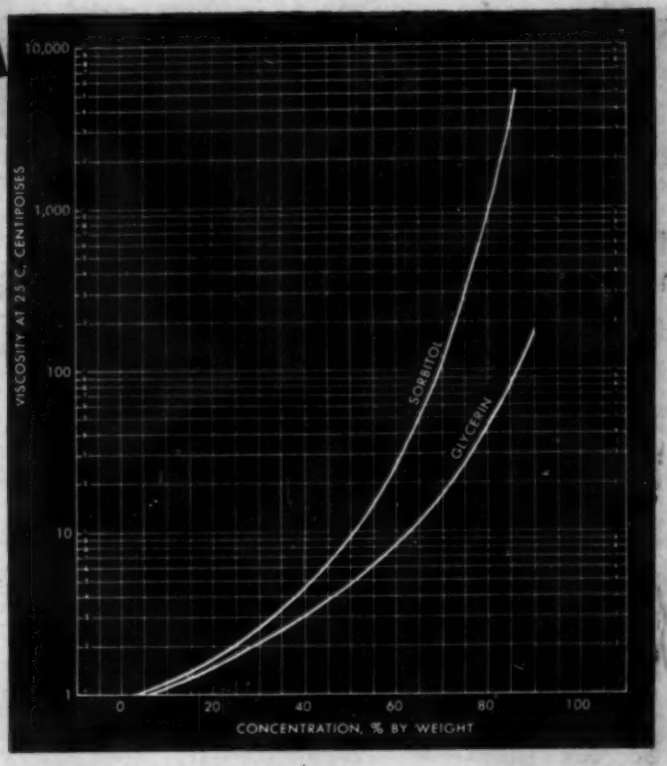

Sorbitol is a polyhydric alcohol with many unique properties which make it valuable in certain types of processing and synthesizing. Chart compares viscosity of sorbitol with glycerin at various concentrations.

SORBITOL
is much more Viscous

Sorbitol solutions are inherently much more viscous than the lower polyalcohols—even at high humidity. Conditioners of moderate viscosity and wide humectant range have a high moisture content at high humidities so that their viscosity is almost like water.

Materials conditioned with lower polyols are apt to be soggy or limp in damp atmospheres. Satisfactory low humidity properties can usually be attained with sorbitol solutions alone, although in some cases they can advantageously be combined with other less viscous conditioning agents.

Other characteristics that increase sorbitol's usefulness as a conditioning agent are its *narrow humectant range*, its slower rate of moisture change at various humidities, and the fact that it is *nonvolatile*. Sorbitol is *compatible* with other materials normally encountered in conditioning problems. Its *chemical stability* keeps it from breaking down or decomposing in use.

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hydrogen chloride from chlorination processes justify a continuation of development work on non-electrolytic processes.

The recently revealed German process described in intelligence reports utilizes a molten salt mixture as catalyst and recovered the chlorine by absorption in sulphur monochloride. This process is believed to be competitive in cost with electrolytic processes used in this country.

H. F. Johnstone, University of Illinois, before American Institute of Chemical Engineers, Cleveland, May 12, 1948.

Developments in Recovery of Searles Lake Deposits

SEARLES is one of a chain of arid valleys in California lying to the east of the Sierra Nevada Mountain range and through which a glacial river once flowed. Most of the time the river ended in Searles Lake where dissolved minerals were concentrated by evaporation. The resulting mother liquor now used is the result of equilibrium between evaporation and rainfall.

Although there were two separate periods of inflow and drying up, it has been only recently that a lower salt body was discovered or recognized. This structure, compared with the upper, is low in potash. It does, however, contain comparatively high concentrations of Na_2CO_3 and $Na_2B_4O_7$. Since the lower discovery coincided with an active demand for soda ash on the West Coast, it was a natural decision that this new brine should be used to produce soda ash and borax. A new plant designed to produce 30,000 tons of borax and 60,000 tons of soda ash yearly is now nearing completion.

Absorption of CO_2 into the brine converts the Na_2CO_3 present into $NaHCO_3$ which is relatively insoluble and precipitates. In the primary carbonators, flue gas is used as a CO_2 source, and in the secondary carbonators, CO_2 from the bicarbonate calciners. Carbonation is continued until the pH is low enough to allow the borax to remain in solution. Also helping to keep the borax in solution is the higher temperature caused by exothermic formation of bicarbonate.

The slurry discharged from the carbonators is concentrated, filtered, dried in a rotary dryer and placed in an externally heated rotary calciner to decompose the bicarbonate into soda ash and CO_2. The product obtained is called "light ash." Since it is not the most suitable form of sodium carbonate for many industrial uses because of its fineness and dustiness, it is fed into a crystallizer. Here it recrystallizes as sodium carbonate

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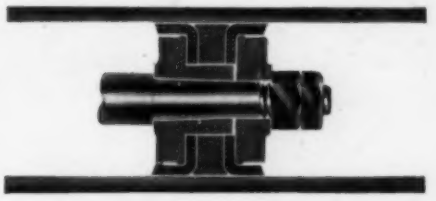
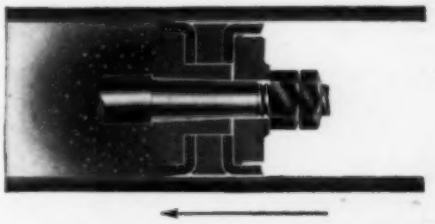


NORMAL: BOTH PUMCUPS RELAXED



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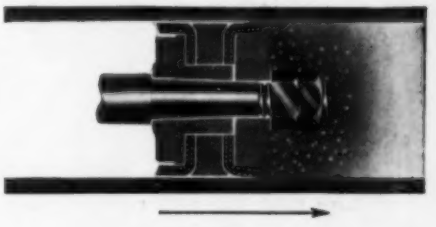

Darcova Pumcups replace ordinary packing in reciprocating pumps and also in air or hydraulic control mechanisms. They are precision built of an exclusive, exceptionally durable composition material available in many textures for use with almost any fluid under a wide range of pressures and temperatures. Standard sizes range from ½ to 42 inches in diameter.

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monohydrate. Any entrained impurities that may have been carried in from the brine are also removed by this recrystallization. Slurry from the crystallizer is filtered, dried and dehydrated in a rotary dryer to form a granular soda ash. Particle sizes are controlled so that the majority is between 20 and 80 mesh in size. This product is screened into two grades.

Going back to the mother liquor discharged from the carbonators, sufficient new brine is blended to bring the pH to the minimum solubility point of borax. This mixture is cooled in three stages of vacuum crystallizers. End liquor is used as a condensing medium in the first stage. Refrigerant is used in the second and third stages. Crystallized borax is thickened, filtered, redissolved and recrystallized to improve its purity and physical characteristics.

W. H. Allen, American Potash & Chemical Corp., before the Southern California Section, American Chemical Society, Los Angeles, March 6, 1948.

Faith in Incentive Economy

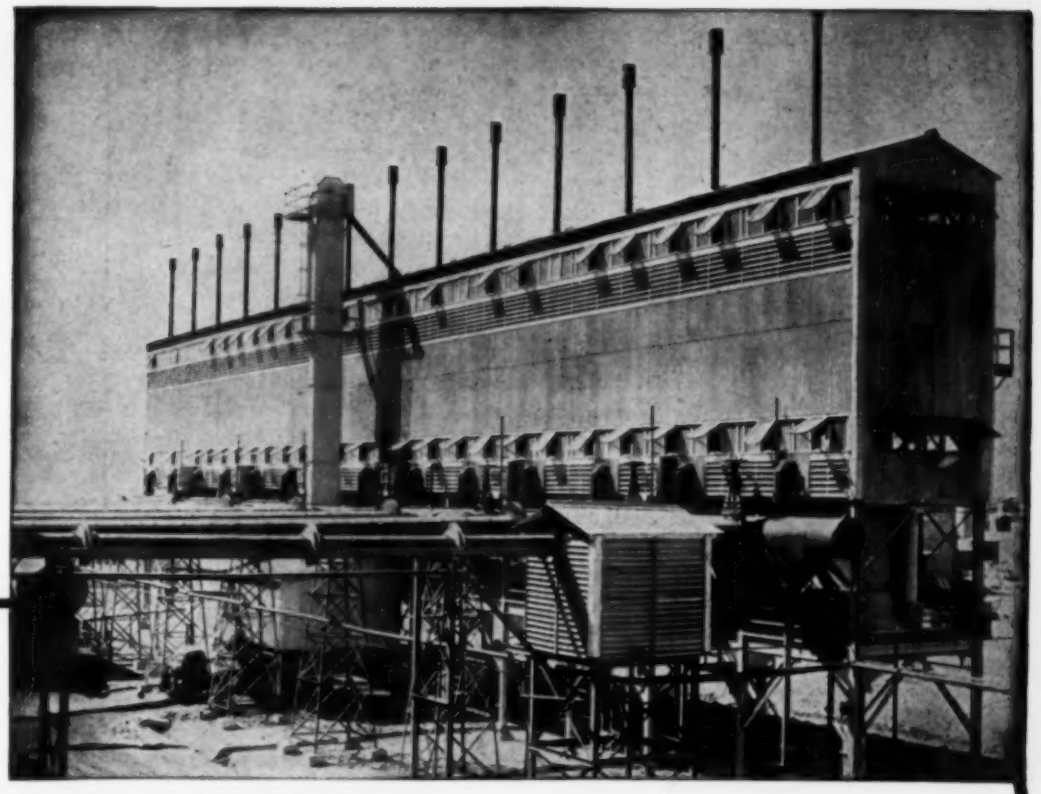
FREE individual incentive is America's greatest national resource. Only because we were free and only because we let man's incentive have full rein has the United States become the most powerful nation on earth.

Rehabilitation of faith is more important that the rehabilitation of property. The material aid we may extend to Europe will avail little by itself. The essence of the European problem is not physical, or material, but one of recreating faith in the ability of the incentive economy to function. Wherever the controlled economy has been tried, the inevitable result has been decline and despair, chaos and collapse, sometimes preceded by war, sometimes not.

In the face of this record of constant failure on one hand, and of success beyond the most optimistic dreams on the other it seems the sheerest madness for any American to allow himself to surrender any part of the faith that has made our experiment in Democracy successful.

We must make it clear that our industrial economy is a partnership operating for the benefit of every citizen; that it brings us goods and services in great profusion; that it brings prosperity and happiness to our workers; and that it recognizes the rights of property and the merits of thrift by offering a return to those who, having saved, are willing to risk their savings in venture capital to provide the tools for our national production.

After the demonstration in World War II of the waste and degradation



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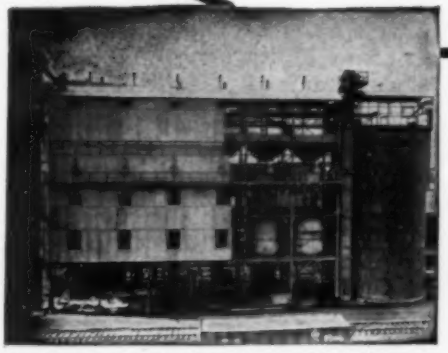
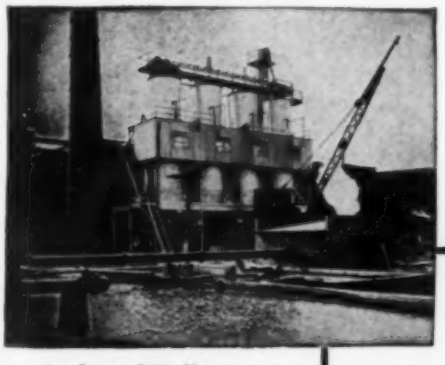


6-unit plant of 10' Wellman-Galusha Gas Generators



4-unit plant of Wellman-Galusha Gas Generators

The Wellman-Galusha is a fully water jacketed gas generator with exceptionally efficient rotary grates, ample fuel storage bins and provision for the generation of steam required for gas making—all incorporated in the machine itself.

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of armed conflict, it seems utterly fantastic that reasoning human beings can continue to rely on force and aggression to resolve their difficulties.

There seems to be one remedy. That is for the United States so to maintain its strength that aggression will be discouraged and the conflicts that swirl about us will be settled by peaceful means. This strength can come only from a vigorous industrial economy.

C. H. Greenewalt, E. I. du Pont de Nemours & Co., before United States Chamber of Commerce, Washington, April 29, 1948.

FOREIGN LITERATURE ABSTRACTS

Hydrocarbons From Carbon Monoxide and Hydrogen

CATALYTIC synthesis of hydrocarbons from carbon monoxide and hydrogen with nickel and cobalt catalysts is based on the reaction $CO + 2H_2 \rightarrow CH_2 + H_2O$, whereupon polymerization of the methylene groups yields unsaturated hydrocarbons which are further hydrogenated to some given degree depending on the condition of synthesis—$(CH_2)_n + H_2 \rightarrow C_nH_{2n+2}$. The products of synthesis are hydrocarbons starting with methane and ending with solid high-molecular paraffins, the yield of the latter increasing with increase in pressure. The synthesis was first carried out under atmospheric pressure, chiefly for the preparation of light benzine hydrocarbons. This process was found to be rather uneconomical and the synthetic gasoline could not compete with the natural petroleum product. Further industrial development of the process involved application of increased pressure, up to 10-12 atm., with production of a considerable quantity of paraffin and ceresin in addition to the benzine. Synthetic paraffin is an excellent raw material for oxidation to fatty acids suitable for soap manufacture and use in the food industry. This synthesis of hydrocarbons is a very exothermic process (48 large cal. per mol) and takes place in a very narrow temperature range. All catalysts for this process require an optimum temperature regulation of ±3 deg. Below optimum temperatures there is a drop in the yields of liquid and solid hydrocarbons due to a decrease in the rate of reaction. An increase of the optimum temperature has an adverse effect on the conditions of polymerization of the methylene groups and they are hydrogenated to

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3. RESISTANCE to CHEMICAL ATTACK

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Strength, especially *hot-strength*, is the quality designers look for first in metals to be used in high-temperature applications.

INCONEL* *has exceptionally high hot-strength.*

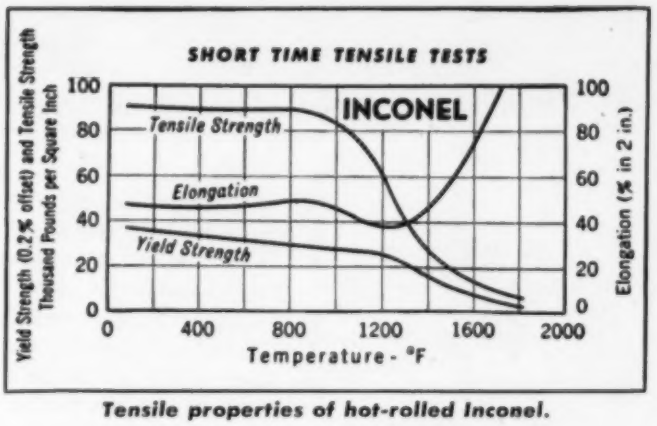
In the heat-treating field, where equipment is constantly exposed to red-heat temperatures, INCONEL has repeatedly set long-time performance records. One fixture made of INCONEL carried full work loads for 13,000 consecutive hours at operating temperatures of 1600° to 2150° F.

INCONEL RESISTS OXIDATION

A metal may resist oxidation at normal temperatures . . . but will it resist oxidation at the high temperatures necessary in processes like natural gas cracking?

INCONEL *will!*

Here's proof: In high-temperature enamel-setting furnaces where oxidation spalling of fixtures cannot be tolerated for fear of ruining expensive finishes – you'll find INCONEL hanger bars standard equipment. INCONEL's tightly-adhering oxide film does not scale to cause product contamination.



Tensile properties of hot-rolled Inconel.

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Where atmospheres are sulfur-free, INCONEL has a plant-proved performance record in successfully handling hot corrosive chemicals such as fatty acids, molten salts, burning gases, sintered metals, ore reductions, and certain organic chemicals at elevated temperatures.

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Get a quotation on INCONEL. You will find it less than you would probably expect. In addition, INCONEL's superior service life and low maintenance requirements often result in outstanding long-run economies.

For economy *plus* serviceability . . . *choose* INCONEL. INCO's Technical Service will gladly help with your specific problems. Your inquiries are always welcome!

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methane which also causes a drop in the yields of liquid and solid hydrocarbons. The yield of liquid hydrocarbons from 1 cu.m. of a $CO + 2H_2$ mixture after a single passage of the gas through the catalyst is considered good and is applicable for industrial utilization even though it is only 51-54 percent of the theoretically possible yield. In recent years it has been found that the process can be directed toward the formation of branched hydrocarbons instead of normal paraffins. This makes possible the direct synthesis of high-octane motor fuel. Work has also been done to accelerate the process itself. Developments and improvements in this field have been so rapid that the methods of production used in German factories are already obsolete. Recent work directed toward the study of new catalysts and improvement of the process itself has shown notable progress.

Digest from "Catalytic Synthesis of Hydrocarbons from Carbon Monoxide and Hydrogen" by V. A. Karzhavin, *Uspekhi Khimii* XV, No. 3, 327–352, 1947. (Published in Russia.)

Properties of Vulcanized Rubber

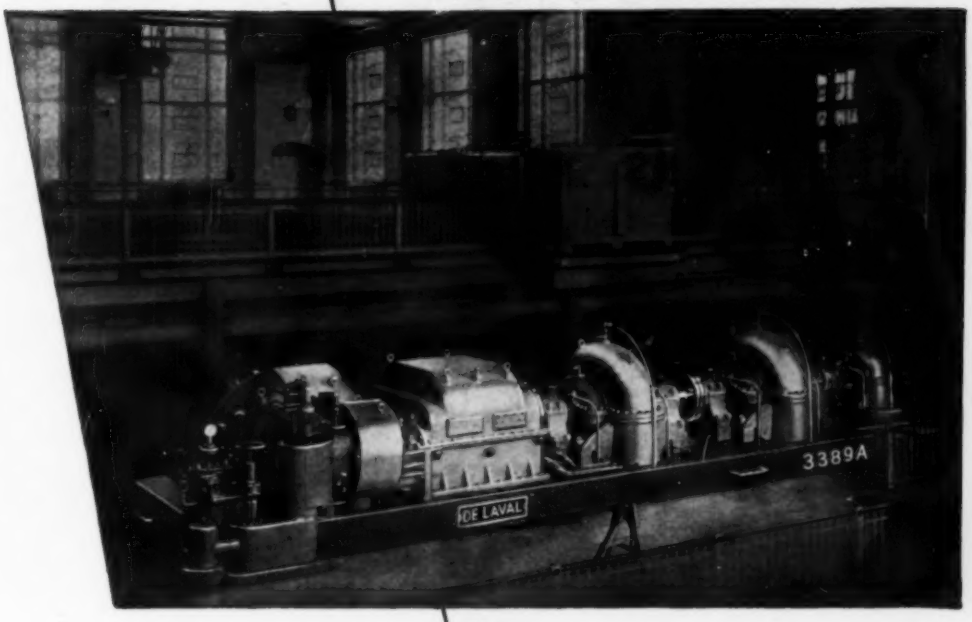
A STUDY was made on the physical-mechanical properties of compositions containing different types of rubber so as to determine most advantageous use of natural, reclaimed and some inferior types of rubber from an economic and technical point of view. A basic formula was used to make up each composition:

Rubber	100
Asphalt 50–60 S.A.E.	5
M.B.T. (Mercaptobenzothiazole)	1
Neozone A (Phenyl alpha naphthylamine)	1
Stearic acid	1
Zinc oxide	5
Kaolin	150
Sulphur	3

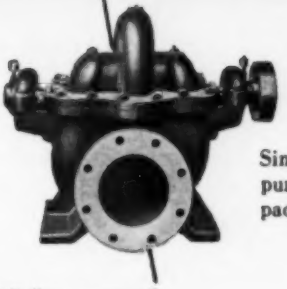
The use of reclaimed rubber with natural rubber facilitated the mastication of the crude rubber, reducing still further the effect of temperature on its plasticity which is a tremendous advantage in the extrusion of rubber articles. The mixtures containing reclaimed rubber vulcanized more rapidly. For a given type of crude rubber, the reclaimed rubber reduces the mechanical characteristics, except in relation to the modulus which appears to be higher, has practically no effect on wear, reduces the specific gravity and results in better resistance to flexion and twisting. The natural rubber—elastomer compositions, corresponding to the natural rubber—reclaimed rubber compositions, have the same rupture load and wearing capacity, greater modulus and specific gravity, less resistance to flexion. The mixtures containing mangabeira have an advantage over the others in that

Different in SIZE

A 4500 hp, geared turbine-driven pump. Capacity 60 million gallons daily at 360 ft. head.



Alike in QUALITY



Single-Stage, Double-Suction pump for relatively small capacities and moderate heads.

The upper photograph shows a De Laval 4500 hp geared turbine driven pump having a capacity of 60 million gallons daily at 360 ft. head. The small pump is a De Laval Double-Suction, Single-Stage Unit having a capacity of 200 gallons per minute at a head of 100 feet.

Both are designed with the same care by the same engineers. Both are built in the same shops to the same quality standards. Both are equipped with such quality features as renewable labyrinth wearing rings for high efficiency over long periods of use.

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they adsorb the charge of ingredients more readily. The mixtures of elastomer with natural rubber have a noticeably greater resistance to flexion than the compositions with only natural rubber.

Digest from "Physical-Mechanical Properties of Vulcanized Rubber Containing Different Types of Rubber" by Massakasu Outa, *Anais da Associacao Quimica do Brasil* VI, No. 3, 203–206, 1947. (Published in Brazil.)

Fused Phosphates for Fertilizers

Conversion of natural phosphates to fused phosphates of the Thomas slag type is a fairly new development in fertilizer technology. Work in this field showed that practically no increase in P_2O_5 in the citrate-soluble form is obtained by heating either "pure" fluorapatite, containing approximately 40 percent P_2O_5, at 1,800 deg. C. with subsequent granulation, or apatite ore, containing 26.5 percent P_2O_5, at 1,635-1,640 deg. or a domestic phosphorite at 1,640-1,650 deg. On heating a mixture of 75 parts by weight of "pure" apatite and 25 parts of SiO_2 in the form of silica gel at 1,800 deg. C. for 15 min. the quantity of P_2O_5 in the citrate-soluble form in the granulated product is approximately 32.8 percent of the total. Heating a mixture of "pure" apatite with CaO and SiO_2 in a given proportion for 10 min. at 1,800 deg. C. results in a practically 100 percent conversion of phosphoric acid into the citrate-soluble form under the conditions of granulation of the fused mixture. On gradual cooling, the quantity of P_2O_5 in the citrate-soluble form is only 30.64 percent of the total. Practically complete conversion of phosphoric acid to the citrate-soluble form could also be obtained with the apatite ore and the phosphorites without elimination of fluorine by the joint action of calcium oxide SiO_2 under conditions of granulation of the fused product. Optimum temperature was 1,550-1,560 deg. C. for preparing fused phosphates with addition of basic blast-furnace slags and lime. The maximum content of citrate-soluble P_2O_5 which could be obtained on fusion of apatite ore with addition of blast furnace slag and lime is 14.5-16 percent for apatite ore and the phosphorites under consideration. The product obtained by fusion of natural phosphates with basic blast furnace slags and lime with subsequent granulation of the fused mixture is equal to Thomas slag both in content of total and citrate-soluble P_2O_5 as well as their properties, except for the fluorine which is contained in fused phosphates.

Digest from "Investigation on Conditions of Preparation of Fused Phosphates" by K. I. Zagvozdkin and N. A. Bariiko, *Zhurnal Prikladnoi Khimii* XX, No. 6, 502–514, 1947. (Published in Russia.)

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FACTS ON FILTERING

Representative case histories on widely varied clarification problems condensed from field reports of Johns-Manville Filtration Engineers

$127.50 Monthly Profit from Orange Oil Formerly Lost

(reported by J-M Engineer H. G. Martin)

LOS ANGELES DISTRICT: A citrus processor in my territory uses high-speed centrifuges for orange oil recovery. After two weeks' operation, there is an accumulation of about 100 gallons of sludge, which has a high content of orange oil. Settling and decanting this sludge yields 75 gallons of oil. By adding Celite to the remaining 25 gallons of heavy sludge formerly discarded and then pressing it, 5 more gallons of orange oil are recovered. Selling for $1.50 per pound, this means a saving of $130.00 in additional orange oil per month. Deducting $2.50 for the cost of Celite used, the operation shows a monthly net profit of $127.50.

Cutting Oil Recovery Increased 12 Times

(reported by J-M Engineer Carl Dietz)

CLEVELAND DISTRICT: This fabricating concern had recently set up an outfit for the recovery of cutting oil from brass, bronze and steel alloy turnings and cuttings. The outfit consisted of a horizontal plate filter, centrifuge, dirty oil tank, and clean oil tank. Having the usual starting-up troubles, they asked for my help.

I found that they had been attempting to operate the filter by pumping clean oil from the filter into a closed tank. This raised the pressure to an excessive level. After correcting this condition, I filled the filter by gravity before starting the pump. Using 7.5 lbs. of Celite 503 per 300 gallon batch, the entire batch was run through in less than an hour. It was apparent that they could take another 300 gallons through the filter—yet previously they had been unable to obtain a throughput of more than 50 gallons.

Since then, no trouble has been experienced. Customer states that in spite of high steam and air charges, he is able to recover his cutting oil at a cost of 3.5¢ per gallon.

Trouble Traced in a Varnish Plant

(reported by J-M Engineer R. J. Amberg)

DETROIT DISTRICT: Recently, a varnish company complained that their filter was not giving satisfactory performance, so I went to the plant to see if I could locate the difficulty. There I found that the hot varnish flows from an elevated storage tank into a 50-gallon drum where the filter aid is added. This drum supplies the filter. During the filtering run, I noted that the operator would occasionally allow the drum to empty and the pump would then pull air for as long as five minutes—draining the filter, "scouring" the filter element and rendering subsequent filtration almost impossible.

The operator was instructed to keep the varnish level well above the outlet pipe. Then, four 400-lb. drums were filtered at an average rate of 18 gallons per sq. ft. per hour with only 5 lbs. gauge pressure at the end of that period. Since that time, these people have had no recurrence of the difficulty.

Engineering Help Solves Filtration Problem

(reported by J-M EngineerG. F. Huber)

BOSTON DISTRICT: One of my customers was having difficulty due to the filter powder coming through the ceramic filter medium. I checked the operation with their technical director and found that incomplete venting of the air from the filter body during precoating permitted air to remain trapped in the upper part of the filter. This prevented the precoat suspension from filling the filter and depositing an even coat upon the stone. As the filtration was continued, the liquid level in the filter rose and gradually displaced the air but meanwhile, of course, some filter aid passed through the stone.

I suggested complete air venting at the start of the precoating and installing a valve on the outlet side. This change in operation resulted in a decided improvement and, needless to say, the customer was greatly pleased.

Your New Problem may be an old one to the CELITE Engineer

These case histories show not only what Celite Filter Aids can do but also how Johns-Manville Filtration Engineers can help you. Small, simple changes in equipment or technique often lead to big results because J-M Engineers combine scientific knowledge with wide practical experience on many filtration problems.

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CHEMICAL ENGINEER'S BOOKSHELF

Lester B. Pope, ASSISTANT EDITOR

Toward Surer Mastery

THE GENIUS OF INDUSTRIAL RESEARCH. *By D. H. Killeffer. Reinhold Publishing Corp., New York. 263 pages. $4.50.*

Reviewed by Roger Williams, Jr.

A. E. BUCHANAN recently wrote "One plaint (of young research engineers) is nearly universal and without quoting, here is the gist of it: Nobody ever told us the facts of life about industrial research. If our professors were aware of the philosophy and methods of industrial research they certainly 'held out on us.'" Buchanan's young research engineers can take heart for Killeffer's "The Genius of Industrial Research" gives just those facts of life. Killeffer's stated desire is "to guide the ambitious young researcher, whatever may be his field, to a better understanding and a surer mastery of his craft." The book lives up to its purpose.

In developing the methods of modern industrial research, the first thing Killeffer does, oddly enough, is to take the word "genius" out of research. Even though "genius" is in the title, the first point made in the book is that research is the methodical result of work by groups.

The gist of the book is the retelling of the history of a series of actual research efforts, many of them Perkin Medal addresses. Through the medium of these actual examples, Killeffer makes his points. But perhaps the most interesting thing about the book is not the examples. It is the running commentary that introduces the examples. It is in the commentary that the author makes his real points and gives the reader a real appreciation of how modern research works.

Killeffer begins by pointing out how methodical research is, moves to pointing out the difference between pure and applied research. Then he considers the mental problems of "Thinking Out the Problem," of keeping everyday work clearly defined in the light of a defined ultimate objective. Next the author turns to specific portions of the research whole: process research, product research, equipment research, and pilot plant development. Finally, he considers reports, evaluating research, and patents. Thus the whole sphere of industrial research is covered.

It might appear that Killeffer's book will have its greatest value in teaching undergraduate technical men what they will face if they move into research work. It can do more than that, for it can realign the thinking of many who are in research work today. It will give such men a fresh yet experienced look at the field they are in.

Cellulose Purification

ACTION OF ALKALI UPON CELLULOSE. *By Dr. Albert Schaeffer. Hobart Publishing Co., Washington. $5.*

THE TEXTILE team of the Office of the Quartermaster General surveyed numerous fiber and textile studies of German industry and German investigators under the auspices of Technical Intelligence Information Branch. One of the fruits of the inquiry was a research report prepared at the textile laboratories of I. G. Farben, Hoechst, by Dr. Albert Schaeffer. The value of this document led to its translation for the Quartermaster Corps and release through Office of the Publication Board.

Reproduction by OTS failed to serve the needs and the commercial reproduction here presented was arranged with Hobart as publisher. All of the original curves, chemical reactions, and pertinent data have been reproduced very effectively. The readable characteristics are a compliment to the publisher; they are strikingly in contrast with the often illegible products that occasionally come from some government agencies.

RECENT BOOKS RECEIVED

Acetylene Chemistry. By E. D. Bergmann. Interscience. $3.

Chemical Constitution of Natural Fats. 2nd ed. By T. P. Hilditch. Wiley. $9.

Chemical Engineering Economics. 3rd ed. By Chaplin Tyler. McGraw-Hill. $4.

Fluorescent and Other Gaseous Discharge Lamps. By W. E. Forsythe & E. Q. Adams. Murray Hill. $5.

Heat Conduction With Engineering and Geological Applications. By L. R. Ingersoll, O. J. Zobel & A. C. Ingersoll. McGraw-Hill. $4.

M. I. T. in World War II, Q. E. D. By John Burchard. Wiley. $3.50.

Scientific and Technical Abbreviations, Signs, and Symbols. By O. T. Zimmerman & Irvin Lavine. Industrial Research Service. $7.50.

Synthetic Methods of Organic Chemistry, Vol. I. By W. Theilheimer. Interscience. $5.

Theory of the Stability of Lyophobic Colloids. By E. J. W. Verwey & J. T. G. Overbeek. Elsevier. $4.50.

Chemistry

FATTY ACIDS AND THEIR DERIVATIVES. *By A. W. Ralston. John Wiley & Sons, Inc., New York. 986 pages. $10*

Reviewed by Gordon W. McBride

LONG known to have been preparing this book, the author does not disappoint his many friends. This new book brings together in very readable form a wealth of literature and original work.

Essentially it is divided into two major sections. The first five chapters embrace a description of the fatty acids, their occurrence in nature, their synthesis, and their physical properties. The other section, somewhat larger than the first, devotes six chapters to the synthesis, properties, and uses of the fatty acid derivatives. A concluding chapter of approximately 30 pages is devoted to the "current happenings and changing concepts" within the field of the book, which arose during the course of its preparation.

Over 10 percent of the book is devoted to literature references, numbering more than 5,000. The bibliographic material is presented chronologically at the end of each chapter rather than as an alphabetic author index at the end of the book. While this presentation has some advantages, it also makes it difficult to trace specific publications which may be familiar to the reader. The 40-page subject index seems quite complete.

As one would expect, there is com-

paratively little fatty acid technology treated in this volume. The chemical engineers will find it of great reference value, however, from the standpoint of the fundamental chemistry on which present and future technology must be based.

Charts and tables illustrate the book to a limited extent. In all cases the material seems well presented and the book is mechanically satisfactory.

Cadmium to Chromium

ENCYCLOPEDIA OF CHEMICAL REACTIONS. *Vol. II. Edited by C. A. Jacobson. Reinhold Publishing Corp., New York. 917 pages. $12.*

FINDABLE and clearly set up, reactions in Vol. II cover a second section of the elements taken in alphabetical order. They are: cadmium, calcium, carbon, cerium, cesium, chlorine and chromium. With each reaction, expressed in equation form, is a brief description of conditions surrounding it. Of the 3,331 entries about 1,400 are devoted to carbon.

As in the first volume, entries are arranged alphabetically as to reactant and then as to reagents. There are about four entries per page. A serial number in the top right corner identifies each. Source reference is given and a number in the lower right refers to a list of abstractors in the back. The volume is indexed for names of substances obtained, formulas of substances obtained, names of reagents and formulas of reagents.

The goal of the entire series is to collect as many as possible published inorganic chemical reactions. The editors hope its value as a standard reference will become great enough to induce experimenters to submit abstracts of their findings as soon as the data are ready for publication.

Compendium

ORGANIC CHEMISTRY. *By Paul Karrer, Zurich. Translated by A. J. Mee. 3rd English edition. Elsevier Publishing Co., New York. 957 pages. $8.50.*

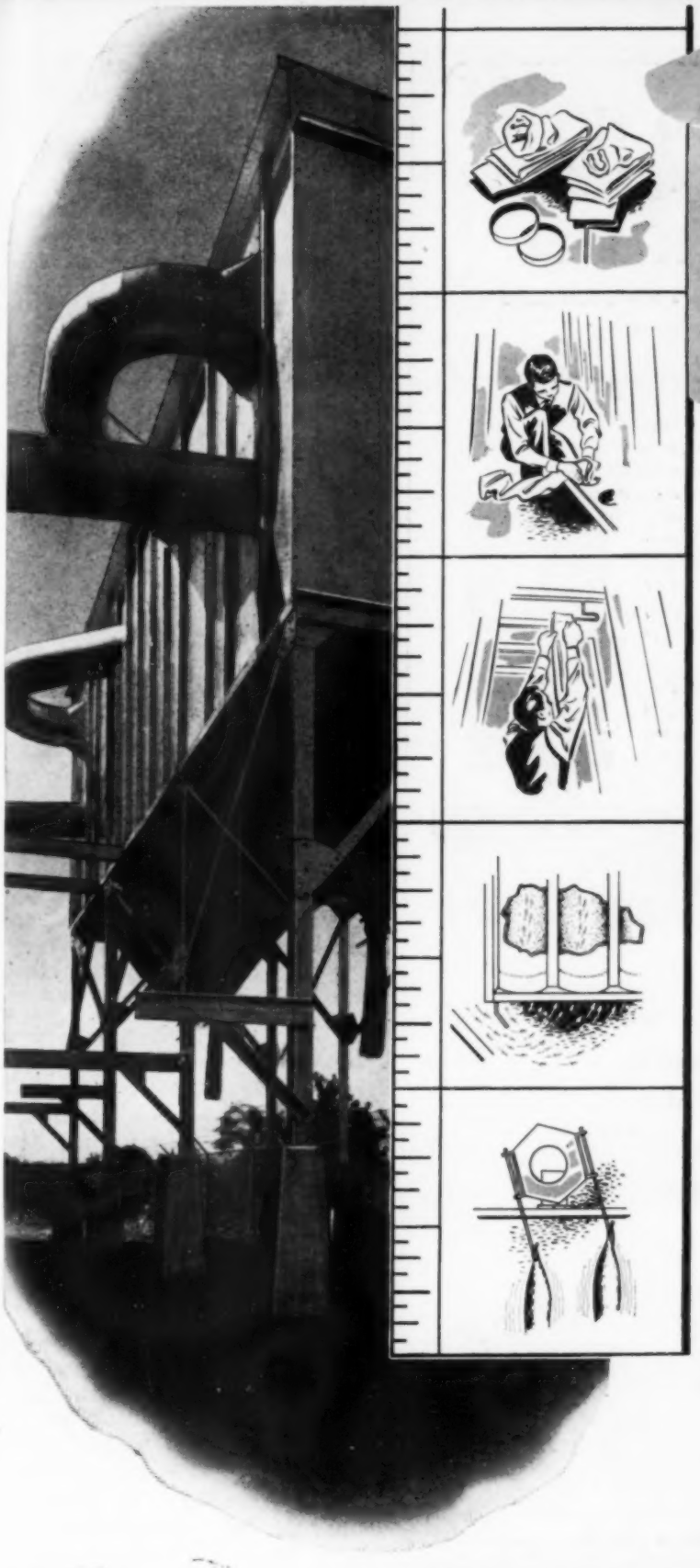
Reviewed by Robert C. Elderfield

IN THE present revised edition of what has come to be considered one of the standard treatments of organic chemistry, as in the earlier editions, the aim of the author has been "to provide students with a textbook of organic chemistry of medium size, which would give them a survey of the ever-increasing body of facts." The general arrangement of the material follows closely that in earlier editions and the major divisions of the book are based on the classical divisions of organic chemistry into aliphatic, carbocyclic

and heterocyclic compounds. The fourth major section, which in the previous edition dealt only with the synthesis of substances with heavy hydrogen, has been expanded to include those with heavy carbon as well. This is most welcome, since the methods described, even though brief, apply equally well to the recently available radioactive isotopes. One wishes that isotopic nitrogen compounds had also been included. Nevertheless, such treatment of this material as is given serves to bring this new and increasingly important phase of organic chemistry to the attention of the reader.

The material presented in the new edition "has been the subject of careful scrutiny and revision; where necessary, passages have been re-written to bring them into line with the results of recent investigations." This is without doubt true in so far as the inclusion of more recent developments such as an outline of the chemistry of penicillin, the vitamins, many natural products, plastics and other similar topics of current interest is concerned. However throughout the volume Professor Karrer's approach has followed closely the lines of classical organic chemistry with emphasis being placed on the synthetic and degradative methods. It is a source of regret to this reviewer that more attention was not given to the developments in theoretical organic chemistry of the past few years and their application to the older phenomena. The concept of resonance is scarcely mentioned, and then only in connection with the structure of benzene. The whole question of orientation in the aromatic series is treated from the older standpoint of simple rule of thumb *meta* and *ortho-para* orienting groups with scant attention being given to the modern electronic concepts which govern such phenomena. The vitally important acetoacetic ester and malonic ester syntheses are tucked away separately in rather obscure places. It would appear that a better arrangement would involve grouping all such subjects together with a modern treatment of the now accepted theoretical interpretations of the reactions involved as an aid to their practical applications.

The section dealing with heterocyclic compounds has been but slightly changed from the earlier editions. Here again it would be desirable to include a discussion of the more modern interpretations given to such subjects as the methylene bases derived from pyridine and related compounds, electronic interpretation of the important reactions of heterocycles, the amination of pyridine with alkali metal amides and others.



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DUST COLLECTORS

In any attempt to compress the vast volume of facts of organic chemistry into one volume a choice of material to be included is imperative. No two people will agree on such a choice. However it appears to this reviewer that undue space has been allotted to mere tabulation of large numbers of structural formulas of substances such as the various dyestuffs, pyrones and coumarin derivatives and catechols to mention a few. The result is that the work becomes more of a compendium with sacrifice of emphasis on principles.

The practice, continued from earlier editions, of giving references to detailed treatments or reviews of broad specific fields has been continued. This amply points the way for those interested in pursuing such subjects more in detail. However in using previous editions of the text this reviewer has found the lack of more detailed references most annoying. In only too many cases a sweeping statement appears with no direct reference to the original literature to enable one to find the basis for such a statement or further information conveniently. While such practice can be condoned in a less comprehensive treatise, in the reviewer's opinion it detracts greatly from the value of a more comprehensive one.

The typography is, on the whole, excellent. A few errors must almost invariably creep in to any book. Among those noted are the lack of a double bond in the structural formula for strophanthidin on p. 710, a footnote on p. 371 which apparently is to the wrong page and the misuse of the double arrow symbol for the double-ended single arrow resonance symbol on p. 369.

Despite these criticisms, the new edition of Karrer fills a valuable place as a general reference book.

Qualitative Analysis

THE SYSTEMATIC IDENTIFICATION OF ORGANIC COMPOUNDS. *Third edition. By Ralph L. Shriner and Reynold C. Fuson. John Wiley & Sons, New York. 370 pages. $4.*

• *Reviewed by Edgar A. Steck*

THE COLLABORATION of Professors Shriner and Fuson has again made possible improvements in an already excellent book. It has long deserved a place of importance in the library of the research chemist as well as the teachers and students of organic qualitative analysis.

In the third edition, the chapters have been rearranged and integrated to produce a more logical development of the subject. The attention devoted to physical properties of compounds is

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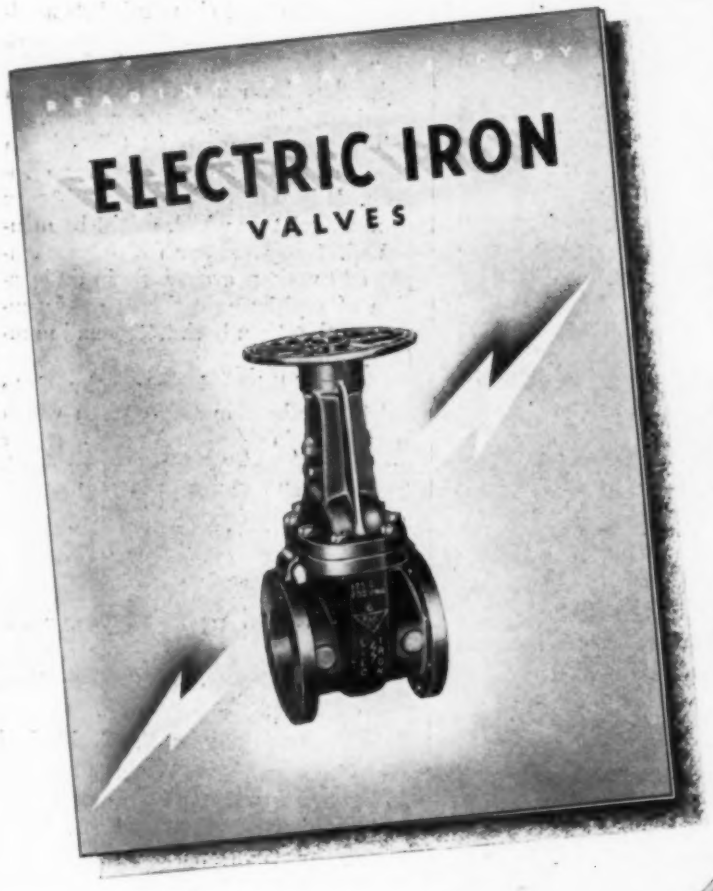

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adequate and more satisfactory in order of consideration than previously. Treatment of solubility classes, classification tests, and derivatives has all been improved through revisions and discussions. The attention paid to recent literature throughout this work is gratifying. The student will gain much indispensable feeling for the science and art of organic chemistry throughout, not the least being in the chapters on mixtures and interpretation of data. Although every instructor will be thankful to the authors for their work, those who must begin teaching organic qualitative analysis and meet a budget will be the happier for having the apparatus and chemicals lists available in the appendix. Introduction of physical constants into the body of the index has been a satisfactory aid in location of individual compounds.

The improvements in this edition have left little opportunity for criticism. It is only the lack of consistency in nomenclature which might be mentioned. One would prefer to have employed numbers exclusively in designation of positions on the aromatic nucleus rather than both letters and numbers.

The publishers have continued to aid the authors in this edition which is smaller in format than the earlier ones. Printing and binding are excellent and will make the use of the book a pleasure.

Research Data

DISASSOCIATION ENERGIES AND SPECTRA OF DIATOMIC MOLECULES. *By A. G. Gaydon. John Wiley & Sons, New York. 239 pages. $5.*

Reviewed by F. C. Nachod

DR. GAYDON of the Imperial College of London has compiled a very useful text on disassociation energies. Leading off from an introductory discussion of spectra, he deals with potential energy curves, correlation between atomic and molecular spectra, continua, and predisassociation. While the present text is primarily devoted to spectroscopical evidence, some chapters are also provided for a brief treatment of electron impact, thermal, and thermochemical methods for the determination of disassociation energies. The final chapter gives the recommended values for 250 molecules in electron volts and kilocalories, as well as literature references. Two appendixes on low-lying energy terms and on heats of formation complete the study.

Most of our knowledge on precise spectroscopic methods is of relatively recent origin, and thus it is not surprising that some of the work is still in a controversial state. It is to Dr.

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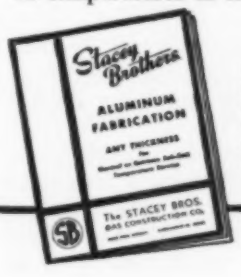

● Write for your copy of this interesting new bulletin, explaining our facilities and illustrating our experience in the field of aluminum fabrication. Ask for Bulletin A-48.

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Gaydon's credit that he shows both sides of the picture and then introduces an element of personal opinion rather than just compiling information uncritically. The research physicist and chemist will welcome this treatise in his bookshelf.

Overhauled

COLORIMETRIC METHODS OF ANALYSIS. *Third edition, Vol. I. By Foster D. Snell and Cornelia T. Snell. D. Van Nostrand Co., New York. 239 pages. $4.50.*

Reviewed by Frederick C. Nachod

THOSE familiar with the second edition of Dr. and Mrs. Snell's textbook on colorimetry, would hardly recognize the third edition as being the same book. The first volume (with which this review deals) has instruments, theory, and pH measurements as its scope, while Vol. II is devoted to inorganic, and Vol. III to organic applications.

Theory and instrumentation which occupied 100 pages in the second edition has been expanded over 50 percent, and emphasis is laid on recent developments in spectrophotometry. The determination of pH, formerly treated in 30 pages has been expanded over 100 percent. Especially helpful is a chapter on filters in which principal spectrum lines and transmission ranges of most commercially available light filters are compiled.

Both teachers and research workers will benefit by this thorough "overhauling" job. The text by the Drs. Snell can be recommended without reservation.

Pest Control

PRESERVATION OF GRAINS IN STORAGE. *Papers Presented at the International Meeting on Infestation of Foodstuffs. London, Aug. 5-12, 1947. Food and Agriculture Organization of the United Nations. Available from International Document Service, Columbia University Press, 2960 Broadway, New York 27, N. Y. 174 pages. Price $1.50.*

Reviewed by Gordon W. McBride

THIS book brings together in one volume up-to-date information on types of pests encountered in various parts of the world, and modern pest-control technology. Authors of the papers include representatives of Australia, Belgium, Canada, Egypt, France, United Kingdom, United States of America, and the FAO itself.

Typical of the interesting material in this volume are charts showing world foci of infestation, and infestation caused by residues of previous cargoes in vessels which reach the

United Kingdom. Countries and commodities are specifically discussed with quantitative indications as to importance.

Liberal bibliographies are included with some of the papers. An index makes this volume a useful reference book for chemical plant management.

Correction

THE REVIEW of "Examination of Industrial Measurements" which appears on p. 294 of our June issue was incorrectly attributed. The review was prepared for "*Chem & Met*" by R. J. Davis of the technical service department, Colgate-Palmolive-Peet Co.

RECENT BOOKS AND PAMPHLETS

Fan Engineering. Fifth edition. Edited by Richard D. Madison. Published by Buffalo Forge Co., Buffalo, N. Y. 808 pages. $6. Handbook on air, its movement and distribution in air conditioning, combustion, conveying and other applications employing fans.

Copper As an Alloying Element In Steel and Cast Iron. By C. H. Lorig and R. H. Adams. Published by McGraw-Hill Book Co., 330 West 42nd St., New York. 213 pages. $3. Data on the properties charactreristics and applications of cast copper steels, wrought copper steels, copper cast iron and copper malleable iron.

Index to ASTM Standards. Published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. 248 pages. As of December 1947, issued yearly. Specifications, methods of testing, recommended practices, definitions of terms, charts and tables.

Charles Tennant. First Tennant Memorial Lecture, published by American-British Chemical Supplies Inc., 180 Madison Ave., New York. 22 pages. Delivered before the Glasgow Section of the Society of Chemical Industry, 1943. Records the work of Charles Tennant.

Analytical Methods for Aluminum Alloys. Published by the Aluminum Research Institute, Chicago. 103 pages. $1. Contains three sections: Sampling of Aluminum Casting Alloys, Chemical Methods, Instrumental Methods.

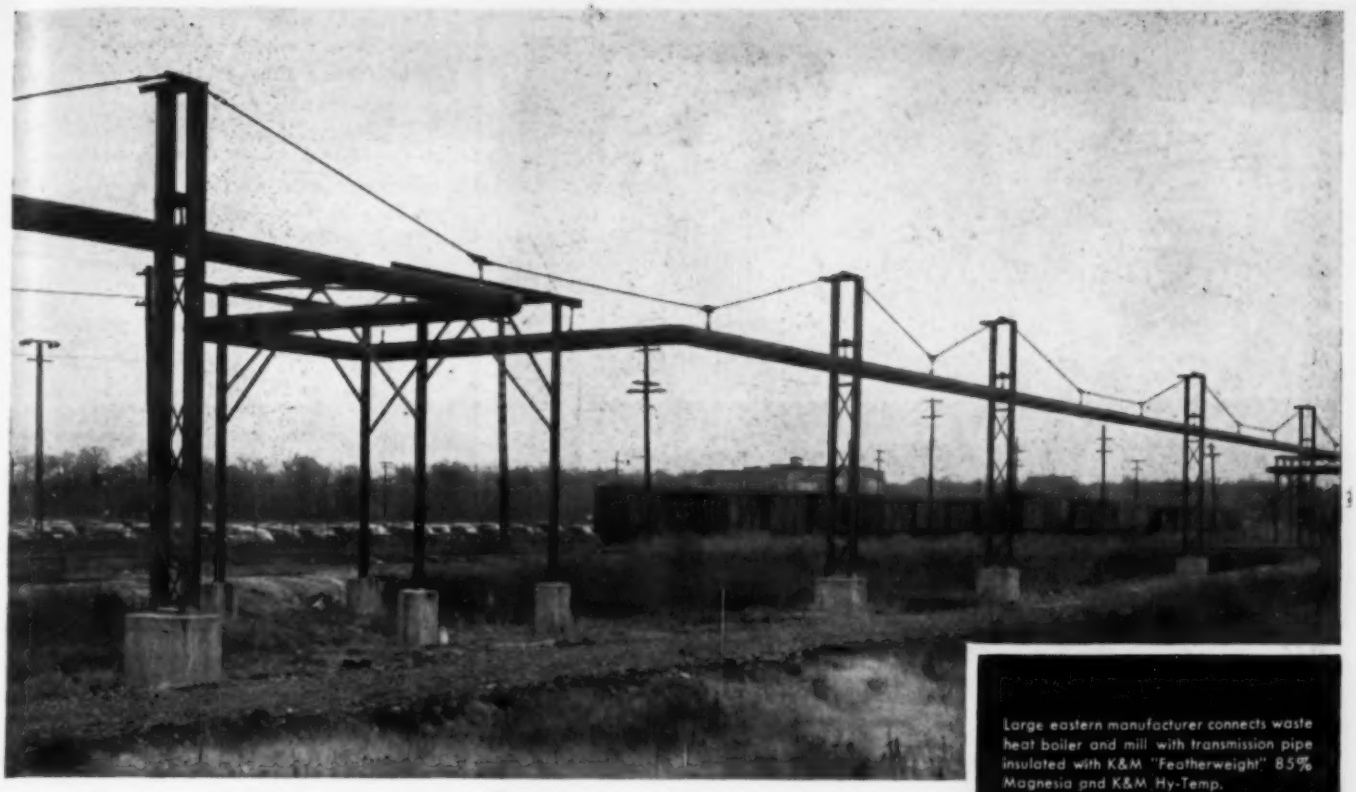
Isotope Chart. By G. Friedlander and M. L. Perlman. Published by the General Electric Co., Schenectady 5, N. Y. Gratis. Data concerning various forms or isotopes of the elements printed on heavy paper, 26 by 50 in. in the form of a long diagonal checkerboard divided into three overlapping sections.

Standards and Top Management. Published by American Standards Association, 70 East 45th St., New York. 19 pages. Gratis. Focuses attention on ASA's long-term financing plan.

Analyses of Crude Oils from 283 Important Oil Fields in the United States. Report of Investigations 4289, published by the Bureau of Mines, 4800 Forbes St., Pittsburgh 13, Pa. Gratis. Includes designation of base of each crude and a table describing the state and county, producing formation and age, depth and physical and chemical properties of each crude and residuum.

1947 Supplements to Book of ASTM Standards. Published by the American Society of Testing Materials, 1916 Race St., Philadelphia 3, Pa. $20. Five-part supplement to all ASTM specifications and tests except chemical analysis of metals.

Insecticidal Surface Coatings. By S. S. Block. Technical Paper No. 19, published by Florida Engineering and Industrial Experiment Station, College of



Large eastern manufacturer connects waste heat boiler and mill with transmission pipe insulated with K&M "Featherweight" 85% Magnesia and K&M Hy-Temp.

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Engineering, University of Florida, Gainesville, Fla. 8 pages. Reprinted from *Soap and Sanitary Chemicals*.

Liquid Fuels Bibliography. Hobart Publishing Co., P. O. Box 4127, Chevy Chase Branch, Washington 15, D. C. $12.50 per volume of index. Indexes of Bureau of Mines abstracts of literature on synthetic liquid fuels. Mimeographed for distribution in three volumes covering the years 1945 to 1947 inclusive.

Proved Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas. Volume No. 2 An 18-page joint report of American Gas Association and American Petroleum Institute, both New York City.

Chamber's Mineralogical Dictionary. Chemical Publishing Co., Inc., Brooklyn. 47 pages. $4.75. Contains brief definitions of about 1,400 minerals and mineralogical terms with colored reproductions of about 400 specimens.

Review of Iron and Steel Literature for 1947. By E. H. McClelland. Published by the Carnegie Library of Pittsburgh, Pittsburgh. 23 pages. Lists separately published books and pamphlets.

Aluminum and Aluminum Alloys in the Food Industry. By J. M. Bryan. Special Report No. 50, published by the Department of Scientific and Industrial Research, Park House, 24, Rutland Gate, London, S.W. 7, England. 154 pages. 3 s. Four-part survey.

Waterbury's Handbook of Engineering. Fourth edition. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 386 pages. $2.50. Vest pocket, indexed handbook with tables.

Electrets. By Thomas A. Dickinson. Published by Plastics Research Co., P. O. Box 346, Alhambra, Calif. 32 pages. $2.50. Sets out to show how general-purpose electrets (the electrical equivalents of permanent magnets) can be fabricated from plastics.

Introduction to the Differential Equations of Physics. By L. Hopf. Published by Dover Publications Inc., 1780 Broadway, New York 19, N. Y. 154 pages. $1.95. Introduction to the ordinary and partial differential equations of mathematical physics.

The Refresher Course in Porcelain Enameling. Published for Ferro Enamel Corp., Cleveland, Ohio, by Enamelist Publishing Co., 4150 East 56th St., Cleveland 5, Ohio. 127 pages. $1. Reprinted from "The Enamelist" magazine, revised and abridged from "A Manual of Porcelain Enameling."

A.S.T.M. Standards on Paint, Varnish, Lacquer, and Related Products. Sixth edition. Published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. 580 pages. $4.35. Specifications, methods of testing and definitions of terms.

Oklahoma City Industrial Survey Corporation Code. Published by Oklahoma City Chamber of Commerce, Oklahoma City, Okla. 12 pages. Analysis of the Business Corporation Act of Oklahoma.

Literature Search on the Solvent Extraction of Oleaginous Materials. By B. H. Weil, Marjorie Bolen and Nathan Sugarman. Special Report No. 26, published by Engineering Experiment Station Georgia School of Technology, Atlanta, Ga. 190 pages. $4. Contains additional reference to byproducts from the solvent extraction of peanuts.

Nature of the Chemical Components of Wood. Edited by Clarence J. West. TAPPI Monograph Series—No. 6, published by the Technical Association of the Pulp and Paper Industry, 122 East 42nd St., New York, N. Y. 234 pages. $5. A symposium held under the auspices of the Fundamental Research Committee, TAPPI.

American Wool Handbook. Second edition. By Werner von Bergen and Herbert R. Mauersberger. Published by Textile Book Publishers, 303 Fifth Ave., New York. 1053 pages. $8. Revised reference and textbook for the wool industry.

Hot-Dip Galvanizing Practice. Second edition. By William H. Spowers Jr. Published by the Penton Publishing Co., Cleveland. 188 pages. $6. Material arranged in sequence of operation.

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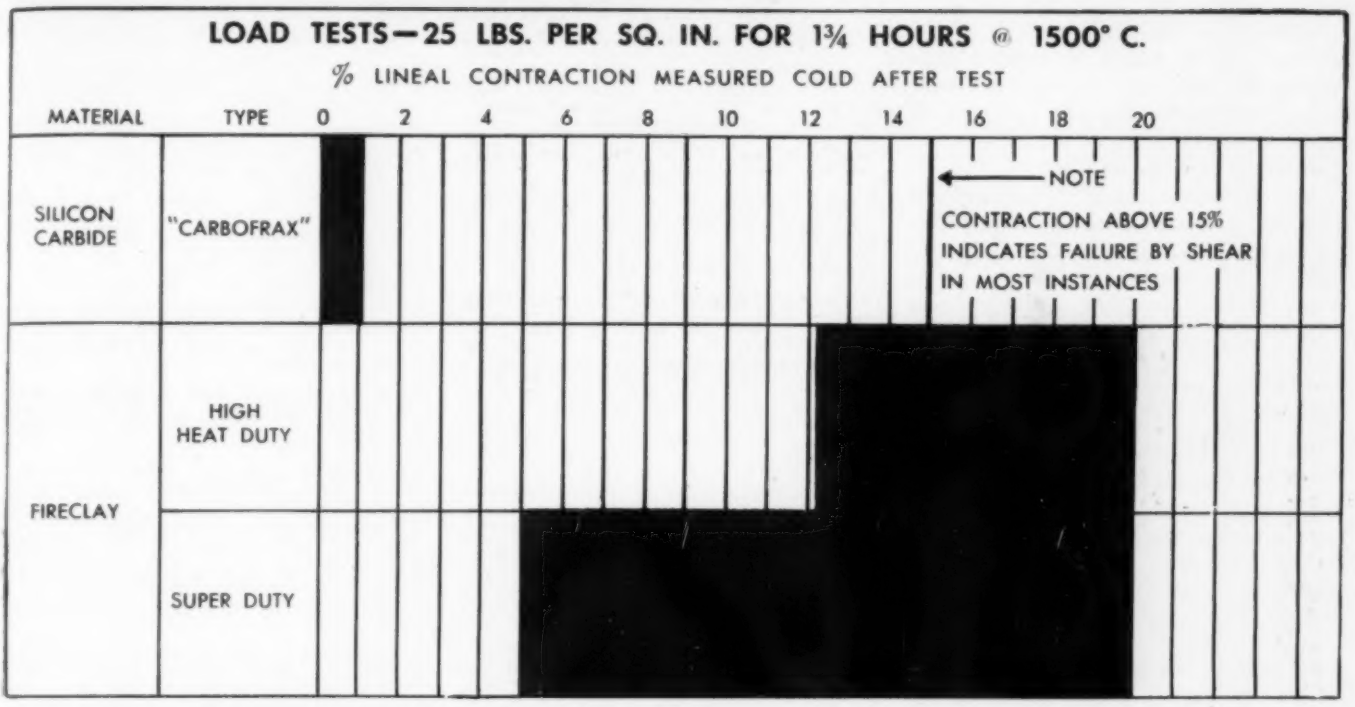

Chart shows the range of values for the different products normally manufactured under each classification.

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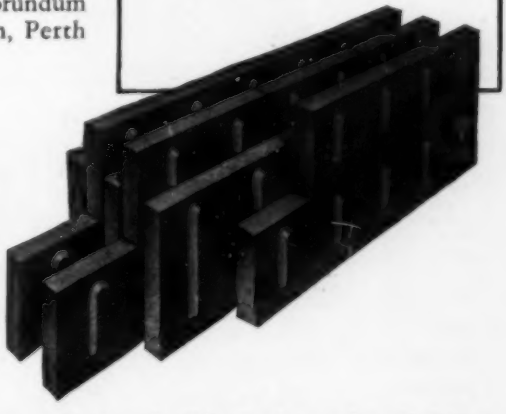

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GOVERNMENT PUBLICATIONS

The following recently issued documents are available at prices indicated from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. In ordering publications noted in this list always give complete title and the issuing office. Remittances should be made by postal money order, coupons or check. Do not send postage stamps. When no price is indicated, pamphlet is free and should be ordered from the bureau responsible for its issue.

Foreign Marks-of-Origin Regulations. U. S. Department of Commerce, Economic Series No. 62. (Revised edition of Trade Promotion Series No. 199.) Price 35 cents. An elaborate list of details of regulations with illustrations for numerous commodities.

Ground-Water Resources of the Cincinnati Area, Butler and Hamilton Counties, Ohio. By Fred H. Klaer, Jr. and David G. Thompson. Geological Survey Water-Supply Paper 999. Price 75 cents.

Quality of Surface Waters of the United States, 1944. Geological Survey Water-Supply Paper 1022. Price 55 cents. Resume of the work of the survey and numerous cooperating state agencies on the composition and character of surface-water supply throughout the country. An excellent reference book for general use and in many cases of considerable value regarding specific local conditions.

Plastics Products. U. S. Tariff Commission, War Changes in Industry Series, Report No. 28. Price 25 cents. An elaborate statistical summary with economic interpretations and review from the standpoint of growth and trends.

Imports of Coal-Tar Products, 1947. U. S. Tariff Commission. Processed. Imports for consumption of intermediates, dyes, medicinals, flavor and perfume materials, and other finished coal-tar products entered in 1947 under paragraphs 27 and 28 of the Tariff Act of 1930.

Armed Services Procurement Regulation. Departments of the Army, Navy, and Air Force, May 19, 1948. Price 25 cents. A manual of procedures to guide the military staff and would-be sellers to the government.

Simplified Practice Recommendation for Copper and Copper-Alloy Round Seamless Tube. National Bureau of Standards, Simplified Practice Recommendation R235-48. Not yet printed, but until printed copies are available, mimeographed copies in limited supply may be obtained on request to Commodity Standards Division, National Bureau of Standards, Washington 25, D. C.

Technical Papers Relating to the Government Synthetic Program. Office of Rubber Reserve, DRP-1. Mimeographed. A bibliography.

Standard Strength and Extra Strength Perforated Clay Pipe. National Bureau of Standards, Commercial Standard CS143-47. Price 10 cents.

Power Market Survey, Missouri River Basin, Area D—Nebraska, Part I—Power Requirements. Federal Power Commission, FPC-P-13. Order from Federal Power Commission Washington 25, D. C. Price $1. The first in a series of five reports which in the aggregate will present the results of a power market survey covering the entire Missouri River Basin.

Principal Electric Utility Generating Stations and Transmission Lines in the United States. Federal Power Commission. Comprising eleven regional maps and six supplementary sheets, the series shows, in general, transmission lines of 22 kv. and above, electric utility generating stations of 1,000 kw. and above and industrial electric generating sta-

tions of 1,000 kw. and above when interconnected with an electric utility. Order from Federal Power Commission, Washington 25, D. C. Price for the complete set $2.50. Order number for the set is FPC-M-8. Individual maps 25 cents each.

Directory of Organization and Field Activities of the Department of Agriculture: 1947. U. S. Department of Agriculture, Miscellaneous Publication No. 640. Price 50 cents. Describes institutions and lists of major technical personnel.

A Summation of Nation-Wide Results with Newer Fungicides. Bureau of Plant Industry, The Plant Disease Reporter, Supplement 176. Mimeographed. Report of 1947 fungicide tests done by the Department of Agriculture and others. Essentially a set of abstracts of experimental findings published last year.

Government Synthetic Ammonia Plants. Production and Marketing Administration. April 1948. Processed. Activities of the U. S. Department of Agriculture relating to disposal and utilization of Government synthetic ammonia plants for the production of fertilizers.

Report on the Agricultural Experiment Stations, 1947. By R. W. Trullinger, et al. Price 25 cents. A resume of station activities in experimental work, especially that largely financed by U. S. funds.

The Microscopic Determination of the Nonopaque Minerals (2d edition). By E. S. Larsen and Harry Berman. Geological Survey, Bulletin 848. Price 50 cents. A reprint.

Plants as Indicators of Ground Water. By O. E. Meinzer. Geological Survey Water-Supply Paper 577. Price 40 cents. A reprint.

Outline of Methods for Estimating Ground-Water Supplies. By O. E. Meinzer. Geological Survey Water-Supply Paper 638-C. Price 15 cents. A reprint.

Analytical Methods as Applied in Petrographic Investigations of Appalachian Basin. By Gordon Rittenhouse. Geological Survey Circular 22. Processed.

Reservoirs in the United States. By G. Earl Harbeck, Jr. Geological Survey Circular 23. Processed. Factual data by states for all reservoirs in the United States having a usable capacity of 5,000 acre-feet or more.

Acid Mine Water in the Anthracite Region of Pennsylvania. By E. W. Felegy, et al. Bureau of Mines, Technical Paper 710. Price 15 cents.

Mining Program, Bureau of Mines Oil-Shale Project, Rifle, Colo. By E. D. Gardner. Bureau of Mines, Report of Investigations R. I. 4269. Mimeographed. Portion of the synthetic liquid fuels program of the Bureau is here reported.

North Alabama Brown Iron Ores. By Andrew Brown. Bureau of Mines, Report of Investigations R. I. 4229. Mimeographed. Largely a geologic report of details of occurrences.

Exploration, Development, Mining, and Milling of a Unique Tungsten Ore Body at the Yellow Pine Mine, Stibnite, Idaho. By John W. Cole and H. D. Bailey. Bureau of Mines, Information Circular I. C. 7443. Mimeographed.

Anodic Deposition of Manganese Dioxide. By Peter Marx, translated by O. C. Ralston. Bureau of Mines, Information Circular I. C. 7464. Mimeographed. Translation of an internal company report file at the Bitterfeld office of I. G. Farben in 1933.

Interpretation of Permissible Limits in the Breathing of Toxic Substances in Air. By H. H. Schrenk. Bureau of Mines, Information Circular I. C. 7457. Mimeographed.

Measurement of Coking Pressure in a Small Laboratory Oven. By B. W. Naugle, et al. Bureau of Mines, Report of Investigations R. I. 4285. Mimeographed.

Determination of Sulfur Dioxide in Air by Means of the Midget Impinger. By S. J. Pearce and H. H. Schrenk. Bureau of Mines, Report of Investigations R. I. 4282. Mimeographed.

MANUFACTURERS' LATEST PUBLICATIONS

Chemical Engineering's Readers' Service, in cooperation with manufacturers, makes it possible for you to secure catalogs, bulletins, and other publications herein listed without obligation (unless a price is specifically mentioned). For your convenience, publications may be obtained by using Reader Service Coupons on pp. 169-170.

(Continued from page 170)

partial list of materials filtered in this equipment.

114. Welding Fittings. Tube Turns, Inc., Louisville, Ky.—12-page pocket sized leaflet giving dimensional data for the various forms of welding fittings made by this company.

115. Filters. Industrial Filter and Pump Mfg. Co., Chicago, Ill.—12-page price list covering rubber lined tanks, fittings and pipe and related equipment.

116. Vegetable Oils. Woburn Chemical Corp., Kearny, N. J.—10 page reprint entitled "New Roads in Science," a talk given by A. G. H. Reimold for the U. S. State Dept. Radio Service.

117. Marking Tags. Metal Marker Mfg. Co., Cleveland, Ohio—6-page folder illustrating this company's standard line of metal marking tags for use in marking, identification and shipping.

118. Rod Mills. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin 07B6718 contains 12 pages, illustrating the various types of rod mills available from this company. Sizes, capacities, and approximate dimensions are tabulated.

119. Textile Dyeing. Dexter Chemical Corp., New York, N. Y.—12-page booklet giving an outline on the history of dyeing and finishing. It is an historical review of the textile dyeing industry.

120. Thermocouple Wire. General Electric Co., Schenectady, N. Y.—8-page booklet No. GEA-4881 describing the insulated duplex thermocouple wire and the bare wire made by this company. Contains information on application, selection, together with tables, operating ranges and other information for the different kinds of couples. Includes price data. A second bulletin GET-1415 contains 24 pages giving tables of thermocouple characteristics.

121. Instruments. B. W. Controller Corp., Birmingham, Mich.—4-page leaflet illustrating and describing the electric, floatless liquid level controls made by this company.

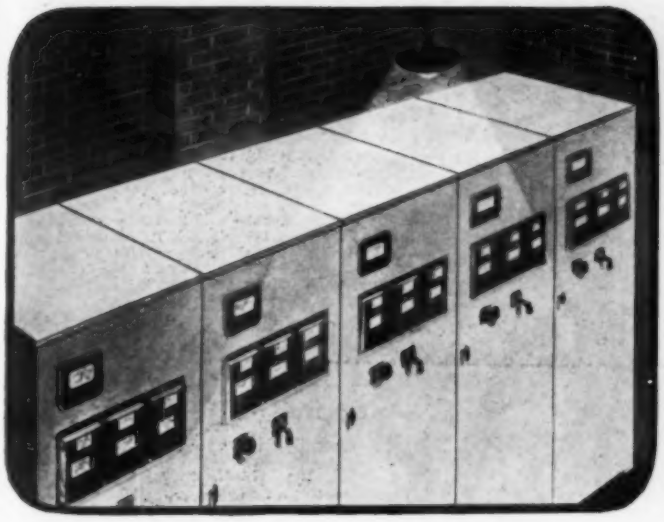
122. Materials Handling. Colson Equipment & Supply Co., Los Angeles, Calif.—4-page leaflet featuring the Cesco dumper for lifting and pouring any free-flowing material.

123. Steam Specialties. Cochrane Corp., Philadelphia, Pa.—20-page bulletin, illustrating and describing the high-pressure condensate return system made by this company. Includes a number of case histories of different applications.

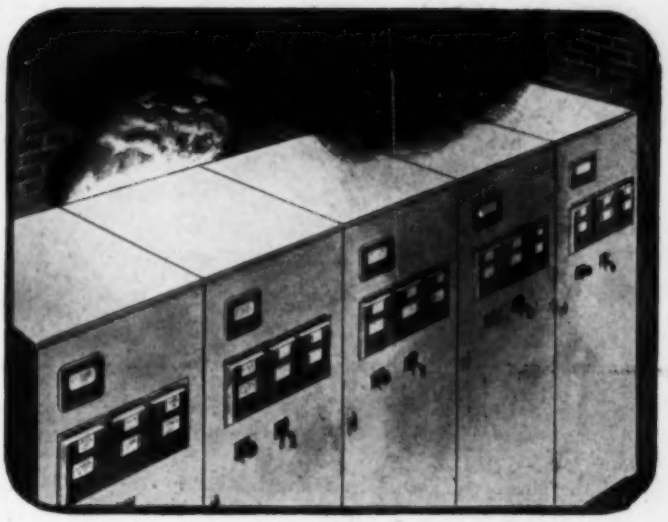
124. Smoke Abatement. Bituminous Coal Research, Inc., Pittsburgh, Pa.—15-page booklet entitled Overfire Jets In Action for Smoke Abatement. Includes installation diagrams for different applications.

125. Fire Pumps. Peerless Pump Div., Food Machinery Corp., Los Angeles, Calif.—8-page illustrated booklet No. B-152 describes the vertical turbine fire pump made by this company.

126. Instruments. Wheelco Instrument Co., Chicago, Ill.—12-page bulletin No. F1-1 illustrates and describes the Flame-O-trol combustion safeguard instrument



A switchboard or control panel—



is a fire-danger spot—

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made by this company. The operation of this instrument is described and wiring diagrams are given. Construction details are shown by use of schematic diagrams.

127. Pulp Beater. Noble & Wood Machine Co., Hoosick Falls, N. Y.—4-page booklet featuring the Victory beater used in refining wood pulp. Details of construction are illustrated.

128. Alloy Steels. International Nickel Co., Inc., New York, N. Y.—Bulletin P-1 contains 26 pages giving the properties of heat treated wrought nickel alloy steels. Contains a large number of graphs and curves.

129. Transformers. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—16-page bulletin No. 11B6935 illustrates and describes construction details of three transformer types: oil filled, Chlorextol liquid-filled and dry type.

130. Conveyors. Hapman Conveyors, Inc., Detroit, Mich.—Catalog No. 4748. 39-page catalog describing and illustrating the rubber flight, sealed in conveyors for handling materials such as dust, chips, and other free flowing materials. Included are engineering drawings of systems for flour, dust, coal, sand and other materials handling applications.

131. Instruments. Bristol Co., Waterbury, Conn.—Bulletin D-616. Two page leaflet illustrating the Series 500 recording gages made by this company.

132. Magnetic Separator. Eriez Mfg. Co., Erie, Pa.—Two page leaflet featuring the non-electric magnetic separator for removing tramp iron from bulk materials. Application of this separator for different industries is illustrated.

133. Cooling Tower. Binks Mfg. Co., Chicago—Four page bulletin No. 36 describes and illustrates the Type 2K-S (spray-filled) steel-case, induced draft cooling towers made by this company. Details of construction together with a table of capacities, sizes and weights. Bulletin No. 37 contains four pages describing the Type 2K-W (wood-filled) steel-case, induced draft cooling tower.

134. Conveyors. Creamery Package Mfg. Co., Chicago, Ill.—Bulletin W-214 illustrates and describes Maguire sanitary solid-frame power conveyors.

135. Testing. American Standards Testing Bureau, Inc., New York, N. Y.—Four-page booklet featuring the testing service available from this company.

136. Fittings For Transit Pipe. Neenah Foundry Co., Neenah, Wis.—Four page booklet describing and illustrating this company's fittings for transit pipe. Details of assembly are shown and tables of dimensions are given.

137. Conveyors. Convair Corp., Pittsburgh, Pa.—Bulletin 101 contains eight pages describing pneumatic conveying systems for the chemical, food, glass, steel and allied industries. Schematic diagrams illustrate a number of applications.

138. Fire Retardant Wood. Koppers Co. Inc., Wood Preserving Div., Pa.—12-page booklet discusses fire-hazard ratings of various building materials, contains information on various fire retardant treatments and lists applications for fire retardant wood.

139. Photographic Equipment. Brown Coating and Equipment Co., Wellston, Ohio—4-page booklet No. B-47 illustrates and describes the company's film processing unit equipped with temperature controls.

140. High Vacuum Furnaces. National Research Corporation, Cambridge, Mass. —8-page bulletin outlining equipment for metallurgical operations in the micron-pressure range.

141. Tube Fittings. Flodar Corp., Cleveland, Ohio—Catalog No. 400 contains 12 pages illustrating and describing tube fittings using alloy spring steel sleeves. Tables of specifications are included. Instructions for assembly of these fittings are given.

142. Cutting Fluids. Standard Oil Co. of New Jersey, New York, N. Y.—18-page illustrated brochure contains detailed in-

FOCUSED on operating costs of a textile plant, a truly candid camera would record this view of valves in proper relation, cost-wise, to other equipment. By the simple photo-magic of showing *all* valves in the plant as *one* valve, the picture points up an important fact—that valves, collectively, are a major investment in *any* plant, *any* large building where operation involves fluid control.

IT PAYS MANAGEMENT to keep this fact in mind. With wages and material costs the highest ever, valve maintenance costs must be watched as carefully as operating expense of larger plant units.

EXCESSIVE MAINTENANCE of one inferior valve is insignificant, but multiplied by thousands, it is a serious drain on operating budgets.

JENKINS BROS. helps you meet this problem two ways. First, by building extra endurance into Jenkins Valves, making them the longest-lasting, lowest-upkeep valves that money can buy. Second, with advice from Jenkins Engineers on any question of proper selection, installation, or maintenance.

For all new installations, for all replacements, rely on Jenkins quality and engineering for lowest valve costs in the long run. Sold through leading Industrial Distributors.

•

Jenkins Bros., 80 White St., New York 13; Bridgeport, Conn.; Atlanta; Boston; Philadelphia; Chicago; San Francisco. Jenkins Bros., Ltd., Montreal.

"PREVENT VALVE FAILURE" is a 28-page guide to valve economy, fully illustrated, with case histories of valve damage, and recommendations for its prevention by proper selection, installation, inspection, and maintenance. FREE on request. Write: JENKINS BROS., 80 White St., New York 13, N. Y.

LOOK FOR THIS TRADE JENKINS MARK DIAMOND MARK
SINCE Jenkins Bros. 1864

JENKINS VALVES

Types, Sizes, Pressures, Metals for Every Need

formation on the selection and use of cutting fluids for use in metal-working. Different types of Esso cutting fluids are listed, together with their main characteristics and applications.

143. Paper. Crown Zellerbach Corp., San Francisco. 22-page booklet presenting a history and description of papermaking in layman's terms. Touches on early history, wood harvesting, barking, chipping, pulping processes, paper making, drying and finishing.

144. Process Equipment. Union Iron Works, Erie, Pa.—Four bulletins illustrate and describe various types of process equipment made by this company. Bulletin M101 contains four pages illustrating and describing equipment for a complete varnish and resin plant built by this company. Contains layout of such a plant, together with illustrations of the major pieces of equipment. Bulletin 120 features the Rad-I-Con kettles and reaction vessels made by this company. Bulletin 121 features Infin reflux condenser in which finned surfaces are located inside of tubes. The fourth bulletin describes Coil-O-Clave method of heating or cooling autoclaves or process kettles.

145. Dust Collectors. Pulverizing Machinery Co., Summit, N. J.—4-page leaflet describing the Mikro-collector for use in collecting industrial dust. Filter rates, dimensions, weights and other details are included.

146. Smoke Indicators. Brooke Engineering Co. Inc., Philadelphia, Pa.—Bulletin No. 20 illustrates and describes electronic smoke indicators and recorders for over-fire jet control. Operation is described, and details of the different devices are shown in diagrams.

147. Agitators. Eclipse Air Brush Co., Newark, N. J.—4-page booklet describing application of the Pneumix air-motored agitator made by this company.

148. Instruments. E. Machlett & Sons, New York, N. Y.—Four page booklet featuring the photoelectric and electronic measuring instruments available from this company. Also a six page pocket-sized folder describing small scale voltage control equipment.

149. Welding. Eutectic Welding Alloys Corp., New York, N. Y.—8-page bulletin featuring the advantages of Eutectic low temperature welding rods.

150. Lubrication Testing Equipment. The Gerin Corp., Red Bank, N. J.—8-page booklet entitled "Taking the Guess Work Out of Lubrication" shows how to measure contaminants in lubricating oil. The booklet features the equipment for conducting these tests.

151. Valves. Kerotest Manufacturing Co., Pittsburgh, Pa.—4-page bulletin illustrating the non-lubricated ball-type valve made by this company. Construction and operation is shown by cut-away views. Sizes and dimensions are tabulated.

152. Alloys. Ampco Metals, Inc., Milwaukee, Wis.—Bulletin 94 contains four pages describing and illustrating Ampco rolled sheet and plate for corrosion- and wear-resistant fabricated equipment.

153. Plaster. General Perlite Co., San Jose, Calif.—An 8-page brochure describing and illustrating the use of perlite plaster. Gives advantages, applications, mixes, coefficients of thermal transmission and other data.

154. Boiler Insurance. Mutual Boiler Insurance Co., Boston, Mass.—Volume 1, No. 1, of a new magazine entitled "The Condenser," has been issued. The first issue dated May, 1948, gives information on safe boiler operation together with several case histories of boiler and power plant accidents.

155. Process Engineering and Development. National Research Corp., Cambridge, Mass.—16-page brochure describing and illustrating the work done by this company in various fields of process engineering such as high vacuum techniques, etc.

156. Asbestos Products. Keasbey & Mattison Co., Ambler, Pa.—16-page 75th anniversary booklet describing the history and development of this company.

Better Porcelain Enameling

"...because the air we serve our guns is clean and free of oil and water."

This Lectrodryer and Lectrofilter safeguard the quality of porcelain enameling work by removing moisture and oil from compressed air fed to spray guns at Pressed Steel Car Company's Chicago plant.

"I can't see why anyone would operate an enameling plant without a dependable means of drying and cleaning the compressed air." That's how thoroughly sold the superintendent of this plant is on the results obtained from this Lectrodryer equipment.

All vaporous moisture in the compressed air that gets by aftercooler, separator and filters is caught by the Lectrodryer. Oil is removed by the Lectrofilter. No water to upset carefully concocted frit mixtures or condense in the lines to form rust and mud. No oil or free water to cause blistering and spotting of fine enamel coatings.

Seven hand guns, four automatic spraying guns and two blow-off guns are served by this Lectrodryer equipment. The system operates at 100 psi.

Wherever you use compressed air—spray guns, pneumatic drills and hammers, instrument controls or the like—you may similarly save by DRYing and CLEANing that air. Lectrodryer engineers will gladly help you determine the facts. Write Pittsburgh Lectrodryer Corporation, 303 32nd Street, Pittsburgh 30, Pennsylvania.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
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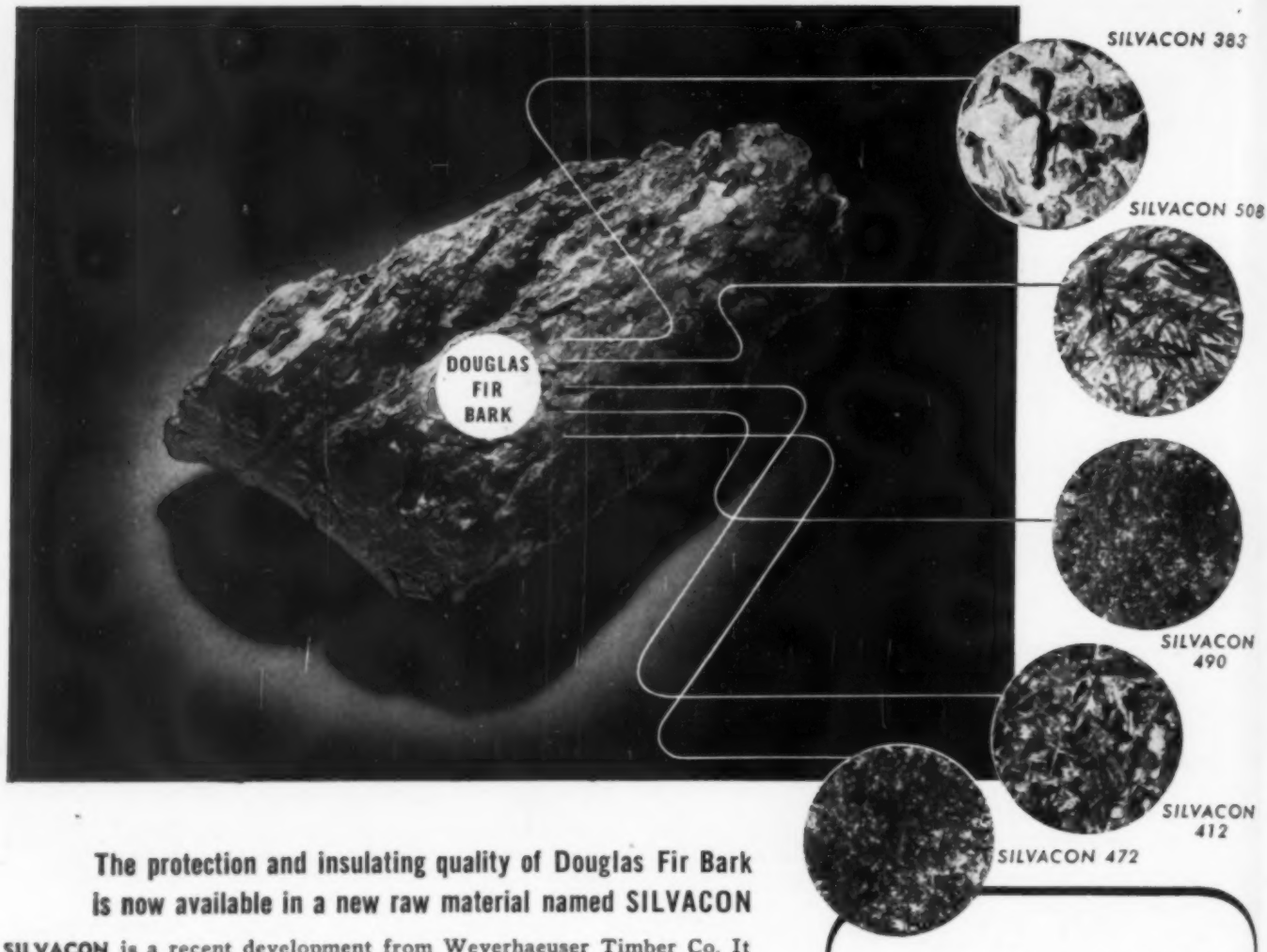
LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

REGISTERED TRADEMARK U.S. PAT. OFF.



The protection and insulating quality of Douglas Fir Bark is now available in a new raw material named SILVACON

SILVACON is a recent development from Weyerhaeuser Timber Co. It opens up untold opportunities for manufacturers and processors to produce quality products at lower cost.

Plastics meet quality specifications at reduced costs; expensive phenolic resins are extended to limits never before thought feasible, producing greatly lowered cost glue lines and binders; insecticide dusts are blended with greater speed and dependable accuracy; magnesite flooring has higher wet strength; asphalt floor emulsion compounds give new resilience to poured floors; rubber compounds have equal quality with lowered material costs... these are but a few indications of product improvements coming to industry and the public through the use of SILVACON.

Technical information about SILVACON is available to you from Weyerhaeuser Timber Co., the largest industrial source of information about wood and wood products. Learn about SILVACON, a raw material so basic that its variety of uses is certain to have valuable applications affecting your business or profession.

SOME DETAILS ABOUT SILVACON

SILVACON is the family name for the constituents of tree bark. Separately they are: **SILVACON 383**, flake-like particles of cork, similar to Mediterranean oak cork; **SILVACON 508**, finely fractionated hard dense lignified fiber; **SILVACON 490**, powdered amorphous material. In addition, there are **SILVACON 412**, a combination of cork and fiber, and **SILVACON 472**, a combination of cork, fiber and powder.

UNIFORMITY. Rigidly controlled manufacturing processes assure uniform quality of SILVACON fractions, singly or in prescribed combination.

WRITE FOR FREE SAMPLES AND TECHNICAL LITERATURE

A comprehensive compilation of physical and chemical properties of SILVACON is available on request. Proved and experimental uses are listed to help you get a quick start in your own product development work. Our development engineers and field representatives will furnish technical assistance. Write Weyerhaeuser Timber Company, SILVACON Dept., Longview, Wash.

A PRODUCT OF Weyerhaeuser DEVELOPMENT **SILVACON**

Building America's Forests for America's Future!

We grow trees. Some of our harvesting programs are planned 100 years in the future. Our continuing search for complete utilization of the forest led to SILVACON. Look for—expect—new raw materials, new manufacturing processes from Weyerhaeuser.

CHEMICAL ECONOMICS

Richard F. Warren, ASSISTANT EDITOR

Chemical Consumption High as Supply Begins to Catch up With Demand

CONSUMPTION and production of chemicals continued at high levels in May and June. However, signs of supply catching up with demand began to appear in some parts of the industry. An example is formaldehyde. The enlarged output of methanol has in turn increased the available amount of formaldehyde to the point where this once scarce item is now in free supply. Adding to the problem of formaldehyde producers is the slack in demand for their product in resins. This was due in part to the recent strike in the plywood industry, the current shortage of phenol, and the coming of vacation time along with a normal seasonal slump in the plastics industry. Other chemicals are also reaching production levels where the supply is satisfying the demand. This is not true in all cases. Many chemicals are about as hard to get now as they have been in months, with little relief in sight.

Chemical Engineering's index of chemical consumption dropped to 232.51 in April from its peak of 243.32 in March. This drop was due to the shorter month and a considerable decline in the fertilizer industry from the March high. However, fertilizer use of chemicals remains high. In April 971,575 tons of superphosphate were produced. Other consuming industries dropped off in April in a seasonal movement. An exception was the paint, varnish and lacquer industry. Sales reported by 680 plants rose to $96.9 million in April, compared with 91.7 million in March. Coal chemicals dropped sharply in April, reflecting the coal strike that occurred at that time.

New Units

Supply of polyethylene is tight and two producers are constructing additional production facilities. Du Pont is building a unit at Orange, Tex., that will probably double total existing output. This will be operating early in the fall. Bakelite is supplementing its South Charleston production by erecting a plant at Texas City, Tex. When all these expansions are completed it is estimated that the total annual capacity of polyethylene will be close to 50 million pounds.

Synthetic glycerine will be produced in sizable quantities late in the summer. Shell Chemical Corp. is reported to have notified its customers that production will start in Houston this month. The plant will have an estimated capacity of 35 million pounds per year, and should be a valuable factor in stabilizing glycerine prices. Several large consumers of glycerine are understood to have contracted for a large part of Shell's output.

Another chemical that soon should be in plentiful supply is benzene hexachloride. Production of this chemical has risen sharply in the past year. March production was 1.6 million pounds compared with 279 thousand pounds produced in March 1947. Sherwin-Williams started production of a new unit in June. It has been estimated that this will ultimately produce 25,000 to 33,000 lb. of benzene hexachloride (100 percent equivalent) per month. This should place the material in a very competitive market as there are at least seven major chemical companies producing the insecticide at the present time.

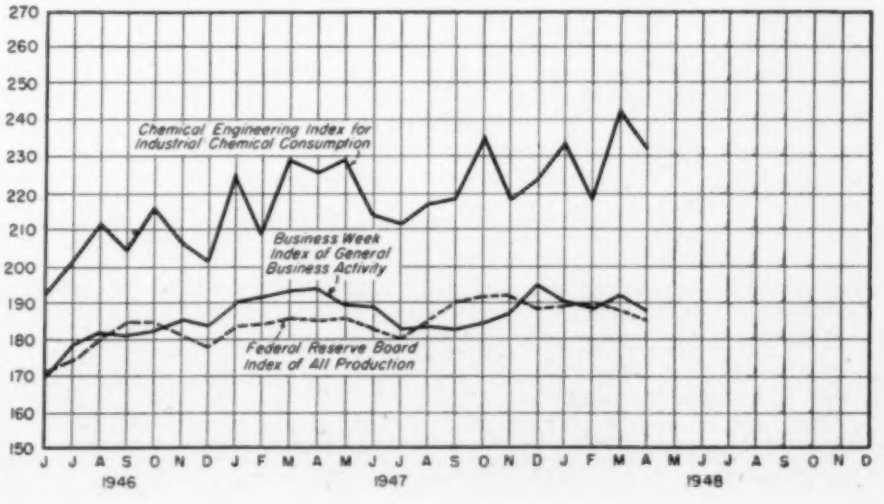
Naphthalene supply outlook is improving. Production was about 15 percent above the 1947 levels in the first quarter. This does not include the effects of the coal strike that will have an adverse reaction on second quarter figures, but 1948 production should be at least 5 percent above last year in spite of these drawbacks. In addition to increased domestic production, Holland, Belgium and Czechoslovakia are shipping this chemical into the country. For the first time since the end of the war, imports of naphthalene are arriving in large quantities.

Chemical Engineering Index

Industrial Consumption of Chemicals

1935 = 100

	(Revised) March	April
Fertilizers	62.10	58.40
Pulp and paper	24.58	23.70
Petroleum refining	21.75	21.03
Glass	20.62	20.30
Paint and varnish	25.40	26.82
Iron and steel	13.98	11.52
Rayon	26.20	25.85
Textiles	12.15	11.55
Coal products	10.28	8.11
Leather	4.57	4.49
Explosives	7.19	7.10
Rubber	5.52	5.06
Plastics	8.98	8.58
INDEX	243.32	232.51



A *Chem & Met* Special Report on

Pricing Systems

Recent court decisions have left a welter of confusion in ruling several pricing systems illegal. Here is a report on the rulings, how they can affect the chemical industry.

THE CHEMICAL industry is no exception to the general confusion that has been generated by the recent Supreme Court decision on cement pricing. By outlawing the basic point pricing system long used in selling cement, the Court not only confused others who are using such systems, it also cast suspicion on other methods of pricing. The trouble right now is that no one knows what the law is and what it isn't. Even FTC cannot help; it will not give opinions, only act after a complaint is filed. It looks as if the situation will not be clarified until March 1949 when the recently authorized Congressional investigation will make the first report to Congress.

All the confusion revolves around delivered pricing, the type of pricing that allows cigarettes to sell for the same price in New York and California, ammonia to cost the same in Houston and Philadelphia. Whether such pricing will be allowed in the future is the open question.

Three Systems

Traditionally, United States producers use three delivered pricing systems: basing point (single or multiple), zone, and "postage stamp." In a single basing point system, shipments by all producers, regardless of their plant location, assume the product was shipped from the basing point and charge the customer for freight from that point. For customers nearer to a producer than to the basing point, a "phantom" freight may be included in the delivered price. Similarly, customers may pay less than the actual freight if they are nearer the basing point than to the producer's plant.

Multiple basing point pricing works the same way as the single basing point, the customer paying theoretical freight from the nearest basing point. This is the system the Supreme Court has thrown out.

Zone pricing divides the country into several geographical areas, a fixed delivered price being quoted for each zone. At the zone borderline companies just across the line from each other may pay considerably different prices for the same material.

The "postage stamp" plan merely means that a fixed delivered price is set, regardless of the location of the purchaser. The company sets the price so that it covers an average freight cost. In extreme cases, the manufacturer may be losing money on far-away sales, making a high profit on nearby sales.

Legal Rulings

Undoubtedly the Supreme Court has ruled concerted action by a group of companies to maintain a basing point pricing system is illegal. Single basing points went out the window in 1945 in the glucose cases against Corn Products Refining and A. E. Staley. Here both manufacturers were quoting fob. Chicago, despite the fact that the three plants involved were at Chicago, Kansas City, and Decatur. The court ruled that customers who were paying phantom freight were being discriminated against and that the single basing point pricing system was a violation of Section 2 of the Clayton Act.

The well-publicized cement case this spring went a step farther and ruled out multiple basing point systems as well. Whether done by a combination of companies or not, the court flatly said, "Concerted maintenance of the basing-point delivered-price system is an unfair method of competition prohibited by the FTC act." The Seventh Circuit Court of Appeals even went further and ruled that there did not have to be evidence of conspiracy. The existence of several companies using the same basing points automatically made the system illegal.

Zone pricing has been under attack too. The crepe paper manufacturers, ding to the court, were violating ...e law by conspiring to use a zone system of pricing. So it looks like collective zone pricing is out too.

The big question in industry's mind is not "What can't we do?" but is "What can we do?" The courts certainly have not helped; they have merely left a welter of confusion.

Present Status

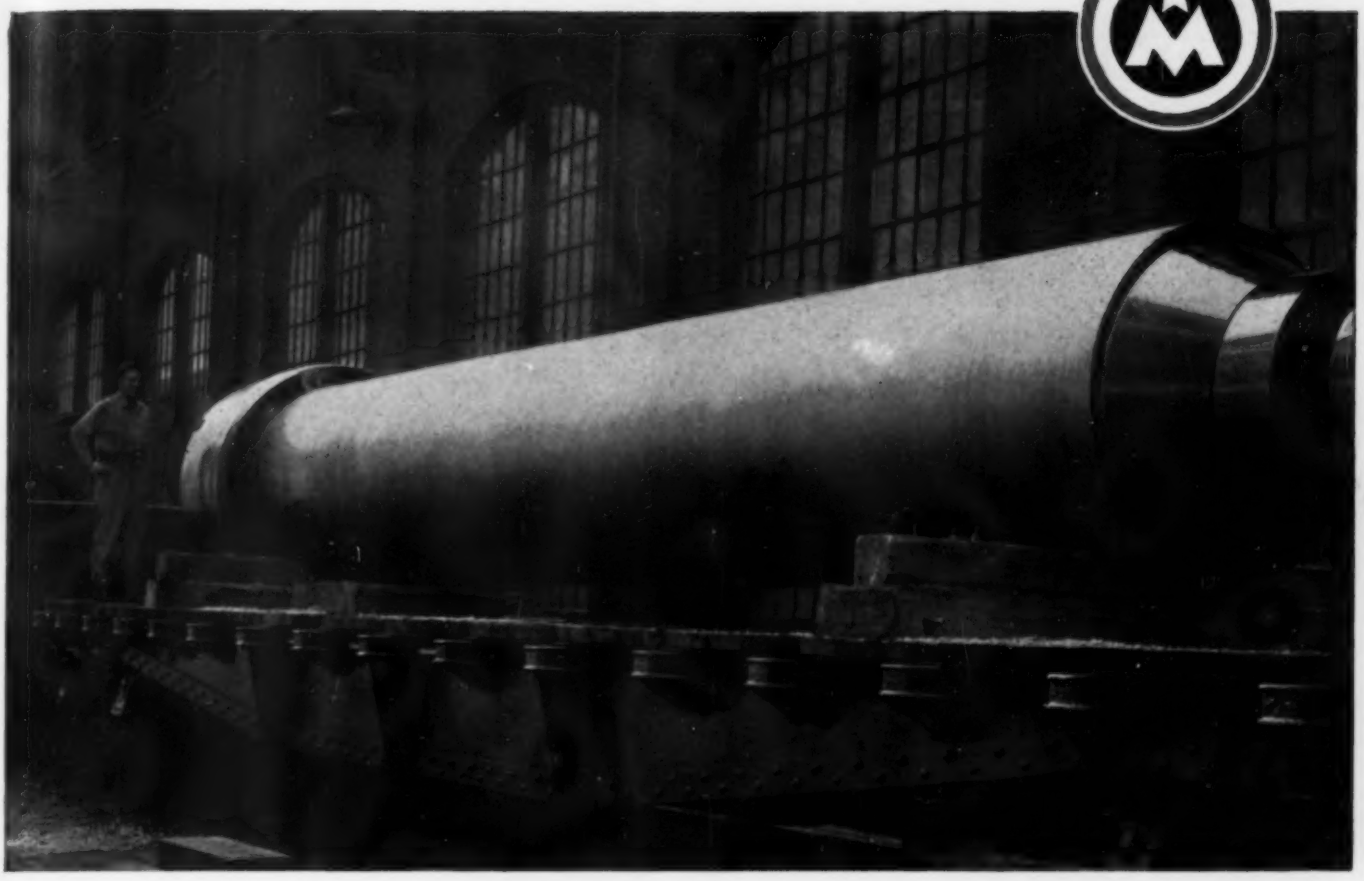
A few things are fairly definite. Any use of basing points by an individual company or a group of companies is clearly illegal. Any use of identical zone pricing by more than one company is also illegal. So far there is no way of te.ling whether "postage stamp" plans are legal or not. The only system that appears to be definitely legal is to eliminate delivered prices entirely and sell on an fob. basis. Even there confusion is possible when a manufacturer has more than one plant making the same product.

The Court added one more note of confusion. It appears that an industry can absorb freight to meet competition if in good faith and occasionally. The Court apparently tried to distinguish between meeting competition on individual sales and the habitual use of the delivered-price systems to equalize prices among all suppliers.

Chemical Pricing

If nothing is done by Congress to change the present court rulings, there will be plenty of chemicals involved. Alum, caustic, soda ash, sulphuric acid, phthalic anhydride, ammonia are just a scattered few of the chemicals which are sold with some sort of freight equalization. Triple superphosphate has close to a single basing point pricing system. Freight is equalized from five points on acetylsalicylic acid. All of these may be subject to a cease-and-desist order when FTC gets around to them.

FTC has hoped that industry would "avail itself of the opportunity now presented to conform voluntarily" to its interpretation of the cement case ruling. But it appears that most industry, and the chemical industry can be included, is adopting a sit and wait attitude. The whole situation is too confused to know what is legal. As one chemical man put it, "If we don't know where we are going, we have no alternative but to stand still."



FORGED STEEL PRESSURE VESSELS

From the smallest to the largest—Midvale makes one-piece hollow forged Pressure Vessel bodies to your specification of carbon, alloy or stainless steel. They're heat-treated, machined, assembled and pressure-tested. Their mechanical properties are proved. All this is done in our plant under rigid Midvale control . . . your assurance of safety and high performance.

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MIDVALE

Custom Steel Makers to Industry

STAINLESS AND TOOL STEEL BARS
•
CORROSION AND HEAT RESISTING CASTINGS
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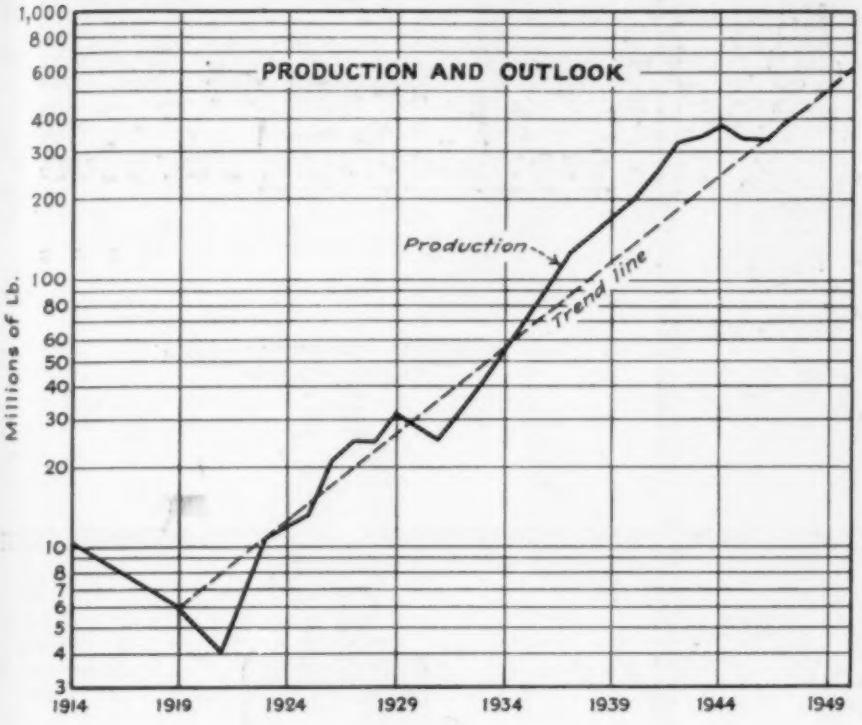


Acetone

ACETONE production in the United States is expected to surpass 450,000,000 lb. this year. Most of this will come from Carbide and Carbon Chemicals Corp., and Shell Chemical Corp. Tennessee Eastman Corp., Commercial Solvents Corp., Publicker Industries, Inc., U. S. Industrial Chemicals, Inc., and Celanese Corp. of America will also contribute substantially to the output.

Generally producers can be broken down into three major types. The first type, fermenters, consists of Commercial Solvents, Publicker, and U. S. Industrial Chemicals. The second major group of producers consists of Carbide and Carbon Chemicals Corp., Shell Chemical, and Standard Oil. These companies, along with Tennessee Eastman Corp. produce acetone from isopropyl alcohol. The third, and newest, type is the butane-propane oxidation process used by Celanese. It is estimated that the over-all capacity of all units is approximately 550,000,000 lb., according to industry spokesmen.

The acetone end use pattern is a complex structure. However, the over-all picture may be summarized by breaking the uses down into the following types: the amount consumed in cellulose acetate in all forms, the use as a solvent in acetylene, its use in chemicals, paint, varnish and lacquer, drugs, and miscellaneous uses including export. Cellulose acetate consumes about 50 percent of all the acetone produced. Production of other chemicals consumes about 15 percent. The paint, varnish and lacquer industry uses about the same amount.

The production and outlook are indicated in an accompanying graph. The trend line shows that acetone production may reach 600,000,000 lb. a year by 1950. Whether this rate of production will be reached is problematical. Shell is bringing in several plants in Europe and England in about one year. This will, of course, have an adverse effect on the export market.

At present the major consumer of acetone is cellulose acetate. About 10 percent of this material is used in plastics. At the present time styrene is making considerable inroads on cellulose acetate market in the plastics industry. Acetate used in this part of the industry cannot be expected to expand. However, the other 90 percent of the cellulose acetate produced goes into yarn. And as long as the natural fibers remain at high price levels, rayon consumption can be expected to grow. Considerable quantities of acetone are used in the paint, varnish and lacquer industry at the present time where some producers of those materials would prefer metyl ethyl ketone. When this becomes more available, acetone consumption may be expected to fall off in this industry. With the completion of current expansion programs, however, producers will be able to supply 600,000,000 lb. of acetone by 1950 should demand for it reach that level.

Up to the time of the first World War, the production of acetone was from acetate of lime. After the war got under way, demand for acetone was greatly increased. Established plant capacities were unable to meet the rise in demand, economic phases of manufacture were unimportant, and vinegar plants were turned over to acetone production.

USI set up a plant at Baltimore which produced acetone by fermentation of molasses. The U.S. and British Governments formed the Commercial Solvents Co., built a plant at Peoria, and produced acetone and butyl alcohol by the fermentation of corn. After the war a new corporation was set up, Commercial Solvents Corp., to purchase the government firm.

Acetone made there undersold the

(Continued on Page 315)

Where It Is Used

End use	Percent
Cellulose acetate	50
Acetylene (solvent)	5
Chemicals	15
Paint, varnish and lacquer	12
Drugs	5
Miscellaneous and export	13
Total	100

Where It Is Made

Producers	Plants	Process
Carbide and Carbon Chemicals Corp.	Whiting, Ind.	Isopropyl alcohol
	South Charleston, W. Va.	Isopropyl alcohol
	Texas City, Tex.	Isopropyl alcohol
Shell Chemical Corp.	Domingues, Calif.	Isopropyl alcohol
	Martinez, Calif.	Isopropyl alcohol
	Houston, Tex.	Isopropyl alcohol
Standard Oil Co. (New Jersey)	Bayway, N. J.	Isopropyl alcohol
Tennessee Eastman Corp.	Kingsport, Tenn.	Isopropyl alcohol
Celanese Corp. of America	Bishop, Tex.	Butane-propane oxidation
Commercial Solvents Corp.	Peoria, Ill.	Fermentation
Publicker Industries	Philadelphia, Pa.	Fermentation
U. S. Industrial Chemicals	Baltimore, Md.	Fermentation

(Continued from Page 313)

wood distillation product, and by 1925, acetone from acetate of lime was of minor importance.

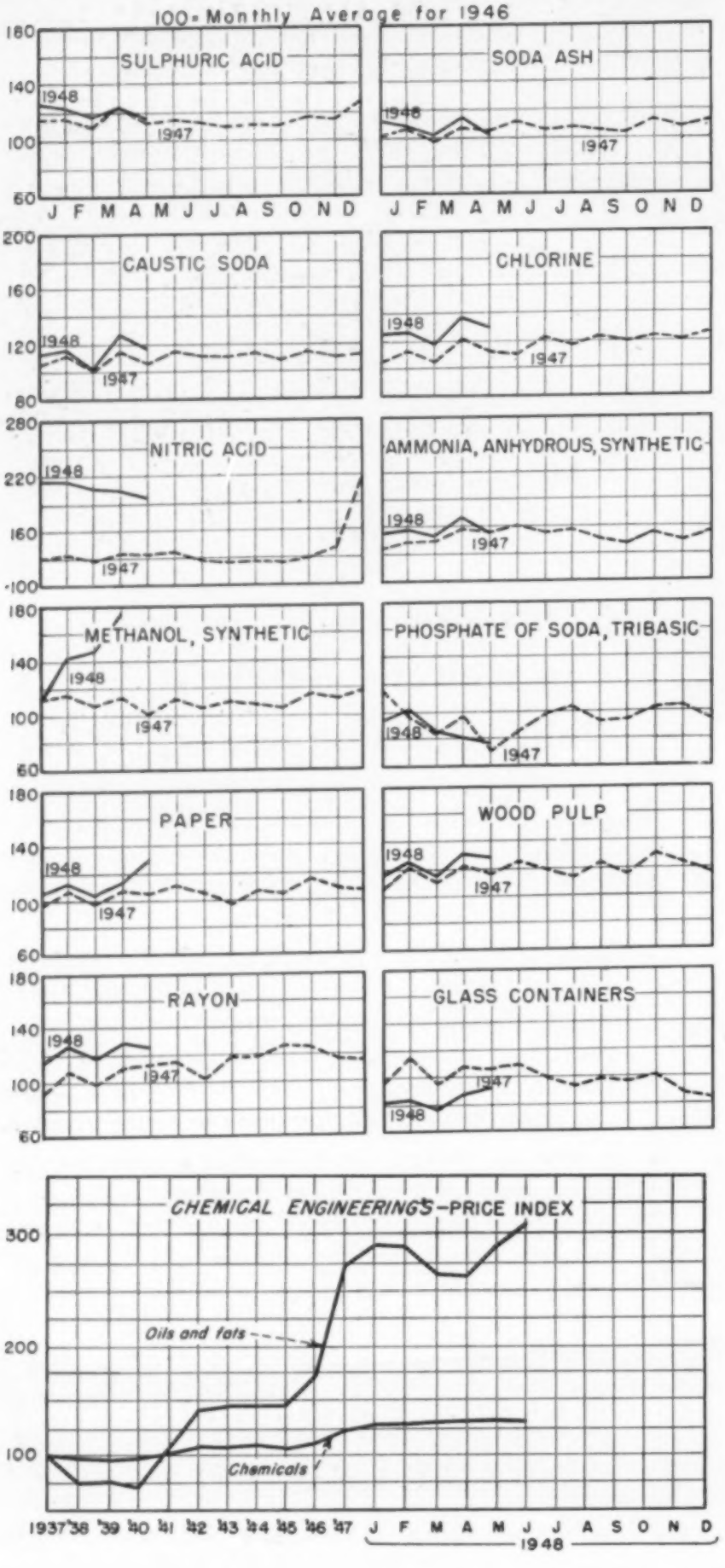
Because they used large amounts of acetone as a solvent in cylinders of acetylene, Carbide and Carbon began research on acetone and developed a method of making it from isopropyl alcohol obtained from petroleum gases. By 1929 this company was producing not only its own requirements, but had entered the market as a seller. In 1930 Union Solvents started a plant for some acetone production by the fermentation of corn. In 1931 Publicker, Inc., added a similar unit to an ethyl alcohol plant at Philadelphia, but used molasses as a raw material. Union Solvents went out of business when the court decreed it had infringed on the patents held by Commercial Solvents Corp. In 1935 Shell Chemical started to make acetone from petroleum gases and is at present one of the leading sellers of this material.

With improvements in processes and a widening of normal market, it was natural to expect a downward trend for acetone prices. For the years immediately prior to 1914 prices ranged from 12 to 14 c. per lb. During the war years they reached a peak level of 46 c. a lb. In 1917 the government fixed the price of acetone at 25½ c. a lb. and this remained in force until 1919. From 1934 through 1939 the price moved down to 4.34 c. a lb. for that year. A strong export movement arose in late 1939 which kept the average sale price from going still lower and brought the unusual situation of some contract holders obtaining delivery at 4¼ c. per lb., while export sales were over 12 c. per lb. At the present time acetone is selling at about 8 c. per lb. in tank cars delivered, as compared with the wartime price of 7 c. per lb.

Anhydrous Ammonia

In the April Commodity Survey on anhydrous ammonia three misstatements have been brought to our attention. It was reported that the Commercial Solvents plant was being almost completely converted to methanol. Actually, a new methanol unit has been built and ammonia production capacity was undisturbed. Lion Oil, reported to be beginning methanol output, is not producing methanol and has no immediate plans of doing so, according to the company. Lion is installing an additional unit which will raise ammonia capacity to about 570 tons per day. Allied's Hopewell plant, listed at 900 tpd. capacity, is probably closer to 750 tpd.

PRODUCTION, CONSUMPTION AND PRICE TRENDS



CAUSTIC soda and chlorine continue to be in somewhat short supply. The supply of soda ash also remains behind demand. Sulphur supplies appear to be ample with a production rate 18 percent above last year. Apparent sales in April, computed from production and change in stocks, are about equal to the 1947 rate.

Synthetic rubber is in good supply. Coal-tar chemicals such as the meta para cresols are still tight. Demand for phthalic anhydride is high and it will probably remain hard to get for some time. Isopropyl alcohol is in free supply.

Glass, a sizable consumer of chemicals, continued to operate in April close to levels reached in March. Plate and container output was about the same in spite of the shorter month. However, container production was almost 15 percent below April 1947. Plate glass, on the other hand, was about 10 percent above the corresponding period.

Rayon shipments rose to 93.6 million pounds in May as compared with 90.8 million pounds in April and 78.1 million pounds in May 1947. Paper production early in June reflected the increase in capacity installed in the past year by operating at rates 14 percent above the corresponding 1947 period.

Price Trends

Prices of heavy chemicals continued to climb in June. Soda ash, caustic soda and chlorine moved upward on July 1. Ethyl alcohol dropped during the month along with turpentine, but declines were more than offset by increases in carbon tetrachloride, DDT, barium carbonate, aluminum sulphate, and others. Reason for the number of upward adjustments is the inability of producers to continue to absorb increased production costs.

Oil and fat prices dropped during June. Edible, drying and essential oils joined some animal fats in a downward movement. The price index for fats and oils reflects this drop.

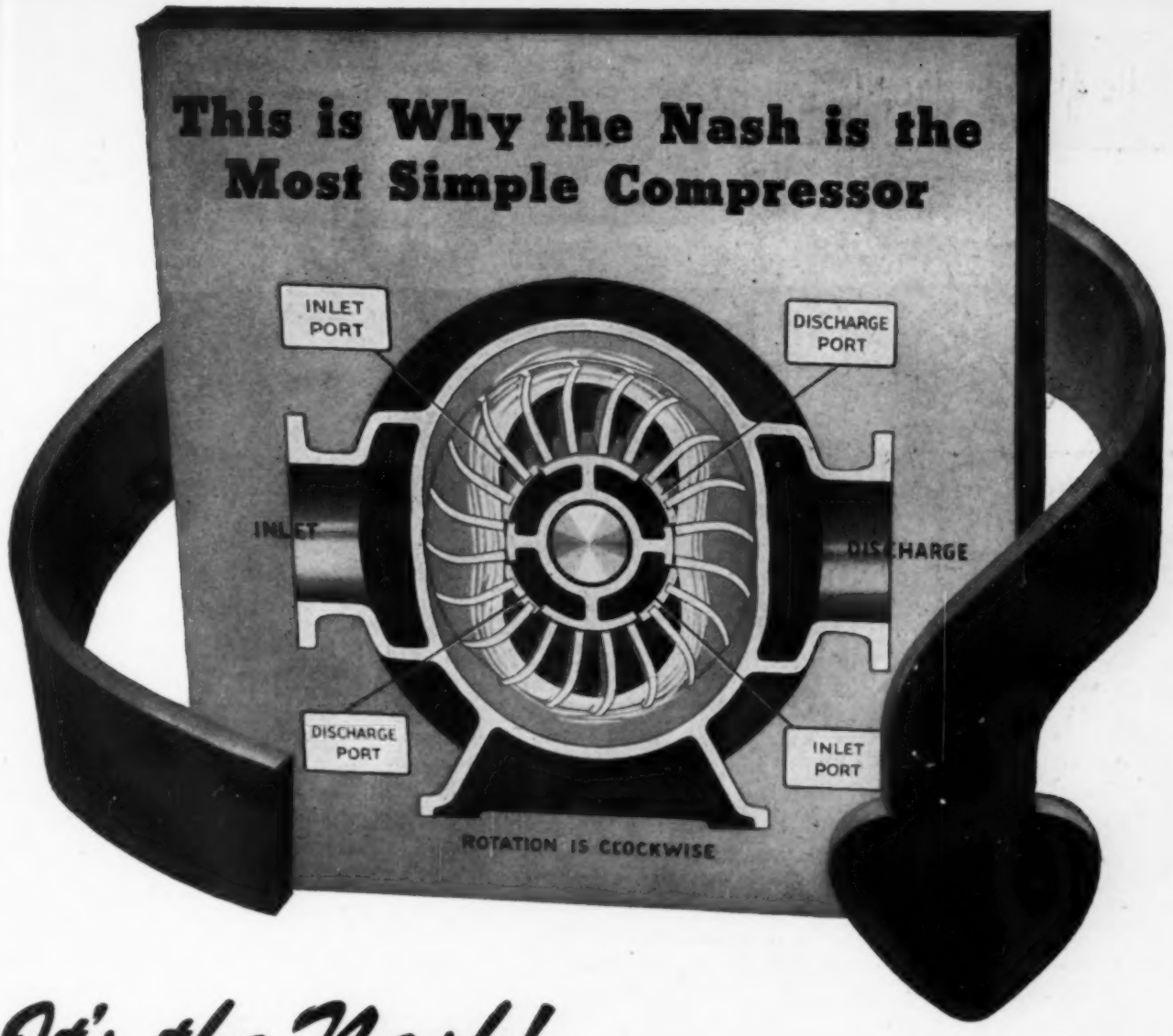
Chemical Engineering

WEIGHTED INDEXES OF PRICES

Base = 100 for 1937

	Chemicals	Oils & Fats
As of July 1..	132.59	293.07
Last Month ...	131.01	308.81
July 1947	123.23	220.34
July 1946	110.50	153.39

This is Why the Nash is the Most Simple Compressor



It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods. Data on these pumps sent immediately on request

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

Desired delivery temperature automatically maintained.

Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY

313 WILSON, SO. NORWALK, CONN.

United States Production of Certain Chemicals

April 1948, April 1947, and Four-Month Totals for 1948 and 1947

Chemicals (Tons unless otherwise noted)	April 1948	April 1947	Total, Four Months 1948	Total, Four Months 1947
Ammonia, synthetic, anhydrous[1]	92,640	93,007	378,737	359,650
Ammonium nitrate	79,976	87,042	359,419	351,192
Ammonium sulphate, technical, synthetic, (M lb.)	28,469	31,121	124,212	117,162
Calcium arsenate (M lb.)	3,910	2,320	11,725	6,540
Calcium carbide, commercial	57,640	51,830	231,225	210,382
Calcium phosphate:				
Monobasic (M lb.)	5,874	6,178	23,192	25,702
Dibasic (M lb.)	6,148	5,209	25,605	25,948
Carbon dioxide:				
Liquid and gas (M lb.)	19,545	17,021	73,714	64,352
Solid (M lb.)	63,715	64,309	196,565	189,739
Chlorine	126,992	109,050	499,122	437,894
Chrome green (C.P.), (M lb.)	1,196	1,307	4,371	5,536
Chrome yellow and orange, (C.P.), (M lb.)	4,925	4,144	17,694	14,521
Hydrochloric acid	36,306	34,637	145,914	140,740
Hydrogen, (million cu. ft.)	2,245	1,503	8,834	6,401
Lead arsenate, acid and basic (M lb.)	3,814	5,470	14,394	18,565
Molybdate chrome orange, (C.P.), (M lb.)	518	434	1,961	1,683
Nitric acid	94,904	64,288	400,325	255,268
Oxygen, (million cu. ft.)	1,362	1,146	5,252	4,475
Phosphoric acid, 50 percent	97,832	82,452	388,861	325,023
Soda ash:				
Ammonia soda process:				
Total wet and dry[2]	357,752	367,847	1,506,195	1,482,822
Finished light[3]	177,047	175,824	680,642	722,805
Finished dense	120,806	131,850	503,180	533,204
Natural[4]	26,288	22,991	95,976	83,378
Sodium bicarbonate	12,596	16,727	44,655	64,112
Sodium bichromate and chromate	8,184	7,099	30,925	27,151
Sodium hydroxide:				
Electrolytic process:				
Liquid[5]	124,002	103,732	486,024	424,358
Solid	20,732	16,948	91,461	69,843
Lime-soda process:				
Liquid[5]	62,298	63,214	255,415	252,142
Solid	19,013	20,736	82,212	80,604
Sodium phosphate:				
Monobasic	781	1,090	2,872	4,704
Dibasic	7,045	5,530	28,217	24,767
Tribasic	6,116	5,540	27,345	27,522
Meta	3,179	1,885	11,761	8,948
Tetra	5,057	4,181	21,214	16,435
Sodium silicate, anhydrous	38,130	50,267	174,451	168,262
Sodium sulphate:				
Anhydrous	15,079	12,829	54,570	47,440
Glauber's salt[6]	15,942	17,362	65,848	60,256
Salt cake, crude, commercial[6]	54,986	52,585	209,275	199,204
Sulphuric acid:[6, 7]				
Chamber	253,727	272,009	1,008,462	1,152,542
Contact, new	587,251	547,322	2,366,686	2,181,200
Zinc yellow, (zinc chromate) (C.P.)	255	191	1,300	965

Data for this tabulation have been taken from "Facts for Industry" series issued by Bureau of the Census. Production figures represent primary production and do not include purchased or transferred materials. Quantities produced by government-owned arsenals, ordnance works, and certain plants operated for the government by private industry are not included. Chemicals manufactured by TVA, however, are included. All tons are 2,000 lb. Where no figures are given data are either confidential or not yet available. [1]Includes a small amount of aqua ammonia. [2]Total wet and dry production, including quantities diverted for manufacture of caustic soda and sodium bicarbonate, and quantities processed to finished light and finished dense. [3]Not including quantities converted to finished dense. [4]Data collected in cooperation with the Bureau of Mines. [5]Figures represent total production of liquid materials, including quantities evaporated to solid caustic and reported as such. [6]Includes oleum grades, excludes spent acid. [7]Data for sulphuric acid manufactured as a byproduct of smelting operations are included.

United States Production of Synthetic Organic Chemicals

March 1948, March 1947 and Three-Month Totals for 1948 and 1947

	March 1948	March 1947	Three Months Totals 1948	Three Months Totals 1947
Acetanilid	190,955	883,338	1,218,250	2,170,370
Acetic acid:				
Synthetic[1]	35,746,342	31,463,095	98,183,889	93,146,161
Recovered	142,867,484	125,981,430	411,709,513	355,116,188
Natural[2]	2,165,385	2,154,460	6,540,725	6,294,997
Acetic anhydride[3]	64,849,357	54,206,388	185,732,429	149,026,115
Acetone	37,766,701	30,301,833	110,063,822	89,899,663

(*Continued on page 320*)

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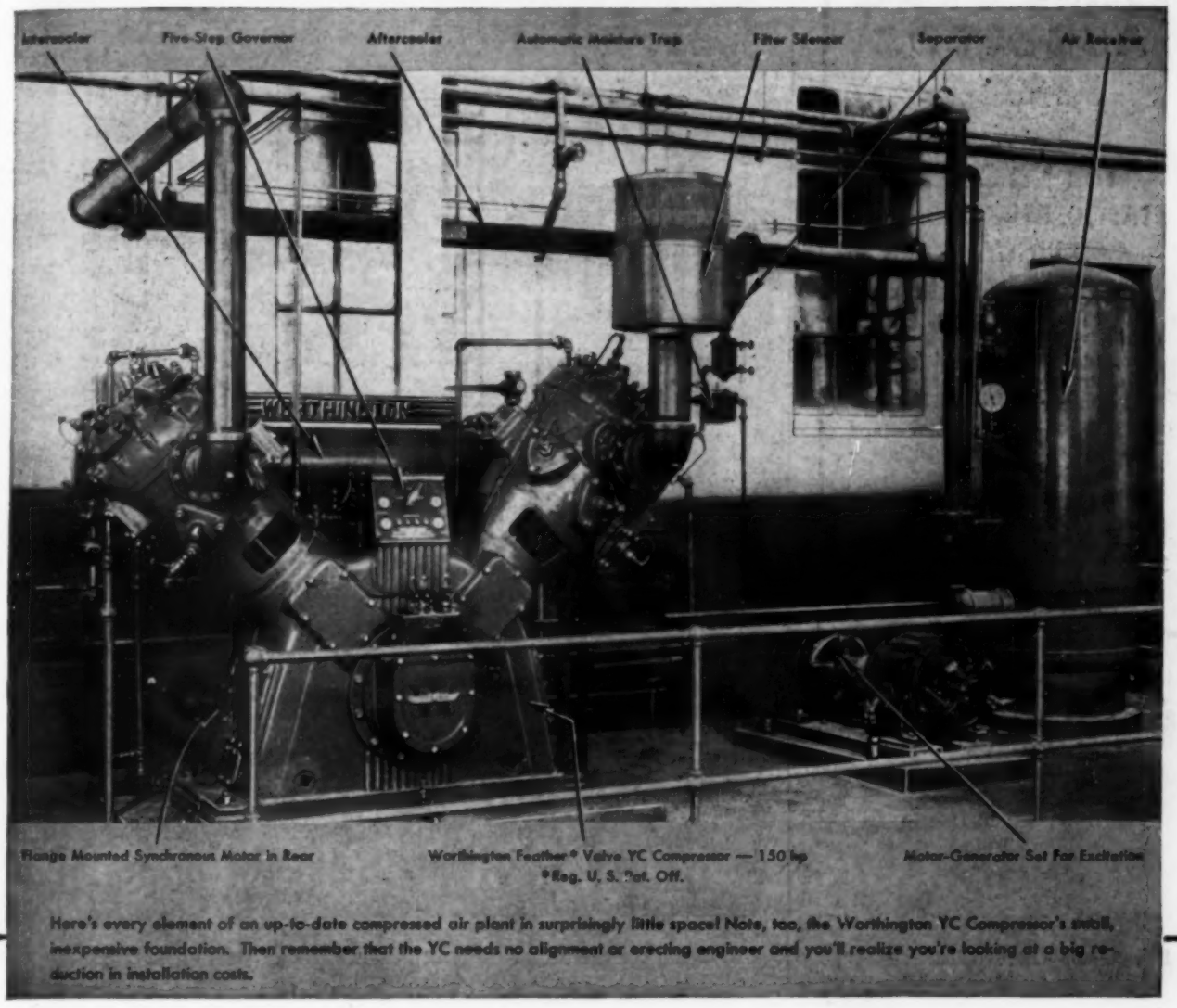

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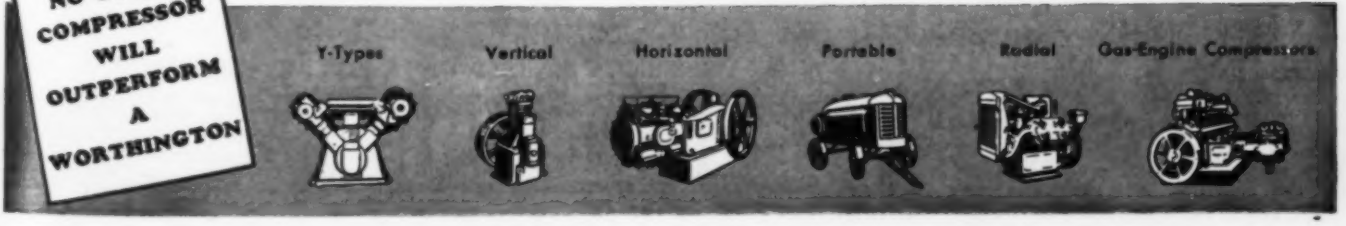

U. S. Production of Synthetic Organic Chemicals (Cont. from page 318)

	March 1948	March 1947	Three Months Totals 1948	1947
Acetylsalicylic acid	1,053,583	831,606	2,017,685	2,780,878
Aniline	9,469,356	9,408,327	26,401,032	28,634,575
5-Ethyl-5-phenylbarituric acid and salts, phenobarbital	44,334	36,575	151,744	100,501
Benzene:				
Motor grade:				
Tar distillers[4]	.....	695,067	.....	2,093,667
Coke oven operators[5]	833,928	1,771,195	1,901,433	5,434,541
All other grades:				
Tar Distillers[4]	1,191,891	1,247,584	3,444,536	5,656,934
Coke oven operators[5]	13,327,285	12,692,241	38,240,042	36,535,435
Butyl alcohol, primary, normal	10,619,183	10,521,123	31,665,580	33,227,556
Carbon bisulphide	33,374,258	30,263,833	104,256,687	86,054,382
Carbon tetrachloride	17,327,714	17,829,018	53,706,242	51,259,341
Chlorobenzene, mono	28,115,483	25,601,394	83,486,306	73,287,948
Creosote oil:				
Tar distillers[4]	9,476,047	11,601,769	27,780,139	33,673,456
Coke oven operators[5]	3,548,942	3,411,455	9,996,476	9,229,579
Cresols, meta-para[7]	903,960	554,430	2,196,822	1,363,702
Cresols, ortho-meta-para[7]	686,410	644,173	1,923,496	3,112,096
Cresylic acid, refined[8, 10]	2,287,487	2,234,164	6,873,699	6,499,957
Dibutyl phthalate	1,259,130	1,720,649	4,809,032	5,715,020
Dichlorodiphenyltrichlorethane (DDT)	2,002,460	4,287,005	6,558,791	12,312,714
Ethyl acetate (85 percent)	5,849,777	7,902,389	16,822,432	25,171,248
Ethylene glycol	28,584,178	15,115,661	74,653,277	47,340,580
Ethyl ether	3,333,390	3,487,683	8,948,667	11,024,668
Formaldehyde (37 percent by wt.)	60,105,226	45,634,834	164,529,565	133,641,405
Hexachlorocyclohexane	1,567,593	279,016	4,236,943	633,427
Methanol, natural[9]	1,352,601	1,293,924	4,120,618	3,983,044
Methanol, synthetic	72,665,317	46,418,582	191,966,983	138,222,668
Naphthalene:				
Tar distillers, less than 79° C.	19,381,642	20,862,905	51,484,325	56,640,785
Tar distillers, 79° C. and over	8,356,000	8,105,233	26,656,277	24,680,128
Coke-oven operators, less than 79° C.	9,008,707	7,316,406	25,664,131	21,029,389
Penicillin and salts	7,832,295	3,220,601	21,490,914	8,986,408
Phenol	26,862,527	21,410,584	76,558,859	21,410,584
Phthalic anhydride	14,082,027	11,689,912	38,562,647	34,223,987
Styrene, government and private plants	30,295,312	22,801,062	87,176,261	92,099,097
Toluene:				
Coke-oven operators	2,456,277	2,409,192	7,189,055	6,482,993
All other[9]	4,656,842	2,530,291	13,962,590	8,641,406
Xylene, crude	5,658,467	5,496,055	14,203,728	13,085,992

All data in pounds except benzene (gal.) creosote oil (gal.), toluene (gal.) xylene (gal.) and penicillin (million Oxford units). Statistics collected and compiled by U. S. Tariff Commission except where noted. Absence of data on production indicates either that returns were unavailable or confidential. [3]Excludes the statistics on recovered acid. [2]Acid produced by direct process from wood and from calcium acetate. [3]All acetic anhydride including that from acetic by vapor-phase process. [4]Product of distillers who use purchased coal tar only or from oil-gas or water-gas produced or purchased by tar distillers. [5]Statistics are given in terms of bulk medicinals only. [6]Statistics collected by Bureau of Mines. [7]Total production including data reported both by coke-oven operators and by distillers of purchased coal tar. [8]Reported to U. S. Bureau of the Census. [9]Includes toluene produced from petroleum by any process. [10]Includes refined creasylic acid from petroleum.